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Fish Kills Caused by Pollution
Fifteen Year Summary 1961-1975

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Analytical text and tables summarize the cummulative fish kill data that was compiled annually during the fifteen year period, 1961 thru 1975. The report tracks the fish kill incidents by pollution source-operation such as agricultural, industrial, municipal, etc. Tables include: a historical summary, number and percent of reports and fish killed by size, major kills, state, type of waterbody, month, and EPA Regions during 1971-1975. Figures display fish kills within counties on individual state maps by size and on charts by percentage of causes.

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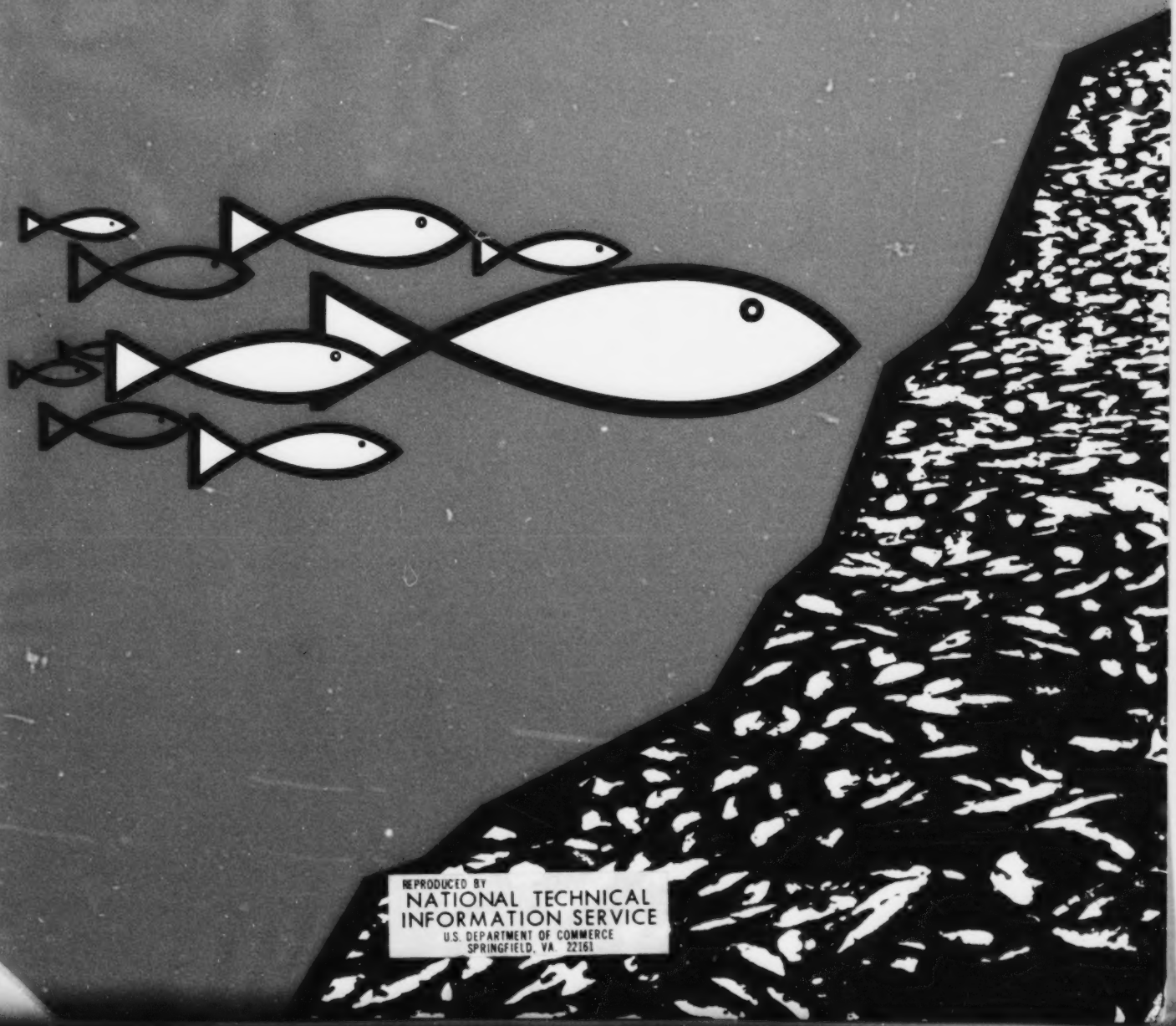

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Project Manager
Edward Biernacki

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Introduction

This report is a fifteen-year summary of information contained in federal fish kill publications, based on voluntary reporting by State and local agencies. The report includes: An analysis of data which describes the number of incidents, the total number of fish killed, the average size of a kill, and the largest fish kill or kills reported. The report also includes the number of reported incidents by each pollution source operation and by the individual sources of pollution under these major operations.

It should be stressed that pollution-caused fish kills reported in this publication probably represent only a fraction of the kills which actually occurred during the 1961–1975 period, partly because the reporting of fish kills is voluntary. Also, numerous small kills often go unnoticed or unreported, and significantly large kills are often not included due to lack of sufficient information to determine if the kills were caused by pollutants, or were due to natural causes. It is often quite difficult to determine the actual cause of a kill, even using the most careful investigative and analytical procedures.

The Public Health Service began reporting pollution-caused fish kills on June 1, 1960, under the authority of the Federal Water Pollution Control Act, PL 84–660, Section 4(C). In 1960, the Surgeon General of the Public Health Service requested that all State fish and game conservation agencies report instances of fish kills attributable to pollutants. Working closely with the U.S. Fish and Wildlife Service and various independent conservation organizations, the Public Health Service designed a self-addressed postcard reporting form (Appendix B). This form was furnished to the State agencies to be completed when fish kills occurred. Summary totals, statistical evaluations, and conclusions were, and continue to be, based upon the information contained in these reporting forms.

In 1972, the responsibility for fish kill reporting was transferred to the United States Environmental Protection Agency (EPA) in an attempt to secure additional information on the effects of pollutants discharged to surface waters. The principal objective was to determine, if possible, the causes of fish kills, and to place responsibility when kills were caused by man-made pollution.

Foreword

The annual EPA fish kill reports represent the combined voluntary efforts of private individuals, State fish and game, health, and conservation officers, and water pollution control officials at the State and Federal level. Usually, a fish kill is first noticed by a fisherman, camper, or other private citizen who initiates the reporting process by contacting a warden or other State official. The State agency then sends trained specialists to investigate and identify the species, the cause, and size of the kill. Where water pollution is determined or suspected to be the cause, the State submits a report to the EPA.

The reporting system depends, to a large extent, upon individuals in the field making State officials aware of fish kills. It is quite likely that the large increases in reports since 1970 over earlier years are at least partially a result of increased public awareness of pollution. In an effort to further increase this awareness and to encourage individuals to report kills to State officials, we are including Appendixes A, B, and C to this report:

- Appendix A—A list of State agencies who should be notified of kills;

- Appendix B—A reproduction of the report form to show the information desired; and

- Appendix C—A definition of the types of operations identified as pollutant sources.

Statistical Highlights

The following are summary statistics of fish kills reported from 1961 through 1975.

- A total of 465.4 million fish were reported killed by pollution during the 1961–1975 period.

- Municipal operations accounted for 195.3 million fish killed (42 percent) and led all other sources of pollution. Industrial operations was second, accounting for 98.5 million fish killed (21 percent). The remaining fish kills (38 percent) were divided among agricultural, transportation, and other operations.

- Industrial operations, with 2,845 incidents (32 percent), led all other sources of pollution in reported fish kill incidents.

- A total of 8,967 fish kill incidents were reported during the 1961–1975 period. The greatest annual number of incidents (860) were reported in 1971.

- A total of 79 reported incidents involving a million or more fish accounted for 360.1 million dead fish or 77.4 percent of all fish killed.

- Florida led all States in the number of reported incidents involving a million or more fish killed (15 incidents), followed by Texas (14 incidents).

- Sewerage systems led all individual sources of pollution in the number of fish kill incidents involving 1,000,000 or more fish (133,000,000 fish—23 reported incidents).

- Ohio led all States in the total number of reported incidents (1,011), followed by Pennsylvania (983).

- A total of 7,253 fish kill incidents (82 percent) were reported on rivers, 1,424 incidents (15 percent) were reported on lakes, and 290 incidents (3 percent) were reported in coastal waters.

- Maryland led all States in the number of fish reported killed (104 million, or 22 percent).

- A total of 47 million fish were reported killed in the largest single reported incident. This major fish kill occurred in the Back River near Essex, Maryland in 1974.

- A total of 335 million fish (72 percent) were reported killed during the summer months of July, August, and September.

- Of the 430 million fish reported killed during the 1961–1975 period, 90 percent were classified as non-game fish.

- Low dissolved oxygen was identified as the leading cause of fish kills during the 1961–1975 period, accounting for 21 percent of the reported fish kill incidents.

- Pesticides led all other specific causes in reported incidents (18 percent).

- A comparison of regional variations of fish kill incidents for the most recent five-year period, 1971–1975, shows that of the 10 EPA regions, Region V (Ohio, Indiana, Michigan, Illinois, Wisconsin, and Minnesota) had the highest percentage of incidents (21 percent), followed by Region IV (Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Mississippi) with 18 percent.

Basic Statistics

In 1961, the first full year of the voluntary fish kill reporting program, 45 participating States reported 413 incidents. During that year, a small number of incidents (9) were identified as major fish kills (100,000 or more fish), accounting for 90 percent of the total reported fish killed. Major kills continued to account for the greatest number of fish killed between 1961 and 1975.

The number of States participating in the fish kill reporting program dropped to 37 and 38 in 1962 and 1963, respectively. It is suspected that this decreased State activity was due to unobserved or unreported kills, rather than to decreased water pollution. Between 1964 and 1971, however, the number of participating States increased, ranging from 40 to 46 States.

In 1972, all 50 States participated in the reporting program for the first time. However, six States reported that there were no recorded pollution-caused fish kill incidents that year.

Between 1961 and 1975, 8,967 reports were submitted involving 465.4 million dead fish (Table 1). Sources of pollution were identified in 84 percent (7,498) of the reports submitted. The annual estimated number of fish killed ranged from a low of 6.9 million in 1963 to a record high of 119 million in 1974 (Figure 1).

It is essential that a fish kill be reported and investigated immediately in order to determine the source of pollution and the polluting agent. Dead fish may be washed downstream from the source of pollution. The polluting agent may be diluted by fast-flowing water, making on-site investigation difficult or even impossible. Hot weather conditions decompose fish tissue, also making it difficult to identify a polluting agent.

Since the investigator can count or estimate only those fish which lie on or near the surface, the number of fish reported killed is almost always a conservative figure. In some cases, as much as 80 percent of the dead fish cannot be counted due to turbid water, or because the fish have either sunk to the bottom of the water body or have been washed away from the site of the kill.

During the 15-year period, industrial operations—the leading source of reported incidents—accounted for 32 percent of all reported incidents. Incidents reported under industrial operations ranged from a low of 20 percent in 1975 to a high of 50 percent in 1962. Industrial operations ranked first in the number of reported incidents for 14 of the 15 years (Figure 2).

Table 1—

	1961		1962		1963	
Number of States responding	45		37		38	
Number of reports	413		421		442	
Reports which state number of fish killed	265		246		304	
Total reported number of fish killed	14,910,000		44,001,000		6,937,000	
Average size of kill[1]	6,535		5,710		7,775	
Largest kill reported	5,387,000		3,180,000		2,000,000	
Number of reported incidents for each pollution source operation						
Agricultural	74		51		84	
Industrial	169		209		199	
Municipal[2]	52		33		60	
Transportation	0		1		17	
Other	58		47		27	
Unknown	60		80		55	
Total reports	413		421		442	
Number of reports and fish killed by size grouping	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)
1,000,000 or more	4	12.6	2	41.0	1	2.0
100,000 to 1,000,000	5	0.85	9	1.69	12	2.68
10,000 to 100,000	45	1.05	38	1.01	54	1.82
1,000 to 10,000	107	0.34	89	0.30	134	0.41
0 to 1,000	104	0.03	108	0.03	103	0.03
No size reported for incident	148		175		138	
Average duration of kill in days		2.64		2.59		3.18

[1] Derived after excluding reports of 100,000 kills or more as being unrepresentative.
[2] Municipal operations include electric power-generating stations.
[3] Figures prior to 1972 were adjusted to correct data errors, and to include data received after the annual fish kill report was published.

Table 1 contains historical data for the fifteen years (1961–1975) that fish kill reports have been received. The table summarizes the following information: The number of States reporting, the number of reported pollution-caused fish kill incidents, the number of reports which specify how many fish died, the reported number of fish killed, the largest single fish kill for each year, the number of reports for each type of pollution source and a breakdown of fish killed by size of kill. The number of incidents and the numbers of fish killed are probably understated because of incomplete reporting and the difficulties of estimating numbers of dead fish.

1974 was the leading year in number of fish reported killed and ranked fourth in the number of reports submitted. A total of 119 million fish were reported killed in 1974, based on 721 reports (Figure 1).

Historical Summary of Pollution-Caused Fish Kills, January 1961-December 1975

1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	Fifteen-Year Summary 1961-1975
40	44	46	40	42	45	45	46[3]	50	50	50	50	
590	625	532	454	542	594	635	860[3]	760	754	721	624	8,967
470	520	453	364	469	492	563	759[3]	697	705	648	543	7,498
22,914,000	12,140,000	9,614,000	11,291,000	15,815,000	41,166,000	22,290,000	73,670,000[3]	17,717,000	37,821,000	119,052,000	16,111,210	465,449,000
5,490	4,310	5,620	6,460	6,015	5,860	6,412	6,154	4,639	5,527	6,532	3,879	5,854
7,887,000	3,000,000	1,000,000	6,549,000	4,029,000	25,527,000	3,240,000	5,500,000	2,922,000	10,000,000	47,112,000	10,000,000	47,112,000
131	114	88	87	77	117	108	132	113	162	145	118	1,601
193	244	195	139	177	199	213	231	189	198	168	122	2,845
120	125	87	91	122	84	120	162	167	148	169	90	1,630
26	27	27	23	39	32	28	52	56	65	40	47	480
17	23	38	35	23	33	28	64	72	56	74	78	673
103	92	97	79	104	129	138	219	163	125	125	169	1,738
590	625	532	454	542	594	635	860	760	754	721	624	8,969

No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	No. reports	No. fish (millions)	Total reports	Total (%) reports	Total fish kill (millions)	Total fish kill (%)
5	16.9	3	5.4	2	.0	1	6.5	3	6.1	4	35.1	5	11.4	28	63.0	6	8.97	6	29.53	6	107.6	3	12.00	79	1.0	360.10	77.4
15	3.82	17	4.62	23	5.48	7	2.66	30	7.44	9	3.15	26	7.44	26	6.37	27	5.43	19	4.65	20	7.1	9	1.87	254	3.0	65.24	14.0
59	1.65	63	1.42	58	1.53	49	1.58	64	1.79	81	2.06	91	2.73	124	3.33	81	2.60	88	2.74	110	3.6	65	1.62	1,070	12.0	30.51	6.7
167	0.49	2	0.59	185	0.55	143	0.46	153	0.48	165	0.52	198	0.62	266	0.86	216	0.62	253	0.81	187	0.6	173	0.57	2,638	29.0	8.19	1.7
224	0.07	435	0.07	185	0.05	164	0.05	219	0.06	233	0.06	243	0.07	315	0.10	367	0.09	339	0.09	325	0.1	293	0.07	3,457	39.0	0.81	0.2
120		105		79		90		73		102		72		101		63		49		73		81		1,469	16.0		
	2.44		2.57		2.71		3.34		2.99		3.11		3.25		3.35		3.40		2.72		3.58		2.18	2.46			

[4] Since six reports submitted during the fifteen-year period did not name the source of pollution, this figure is greater by 6 times the figure 7,492 shown in Tables 3, 4, 8, and 9.

Figure 1—Number of Reports Submitted and Fish Killed, 1961–1975

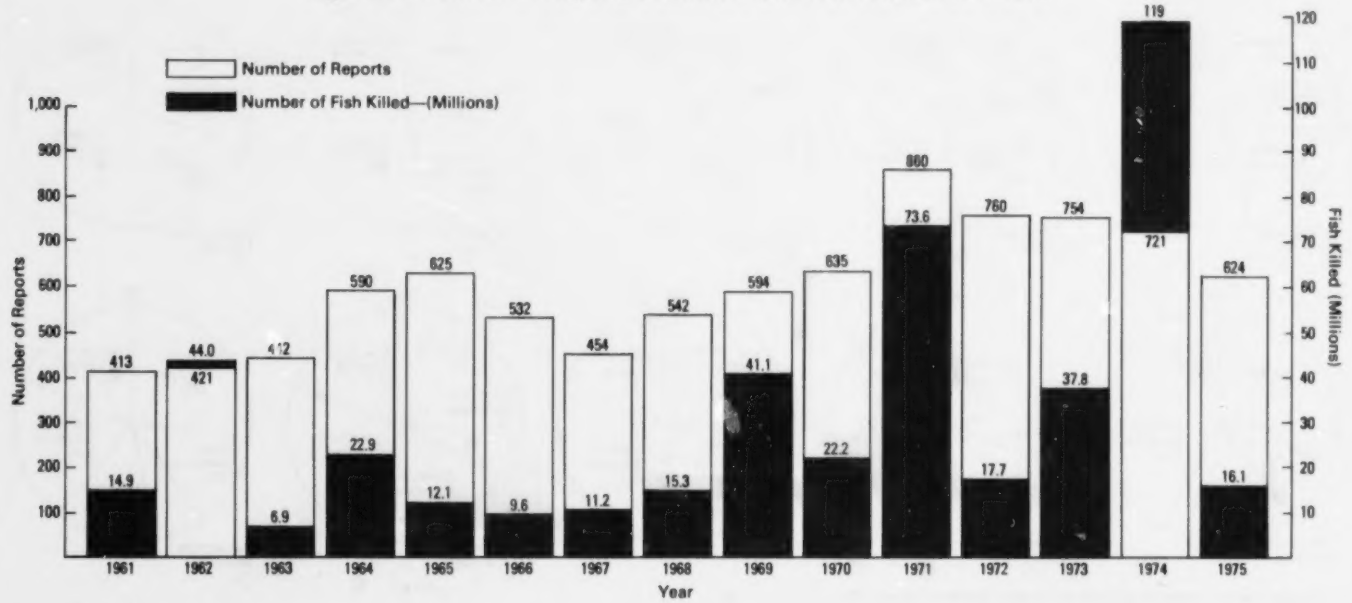
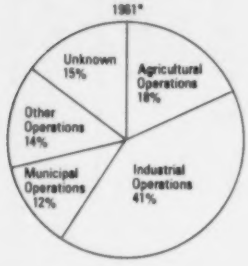
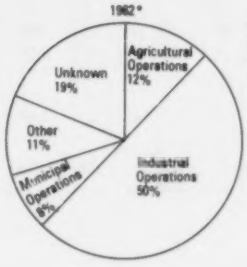


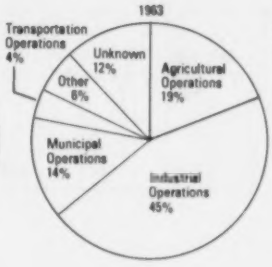
Figure 2—Reported Fish Kills Incidents by Source of Pollution, Fifteen-Year Summary and Yearly Summaries, 1961–1975

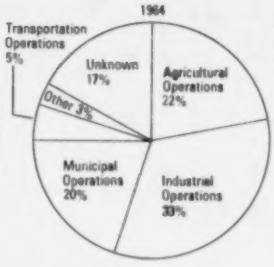
Summary, 1961-1975

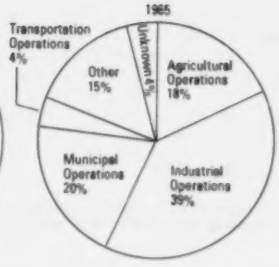
Yearly Summaries

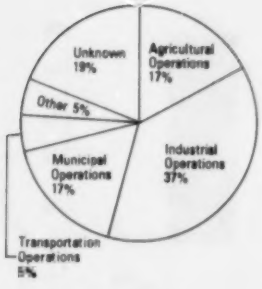


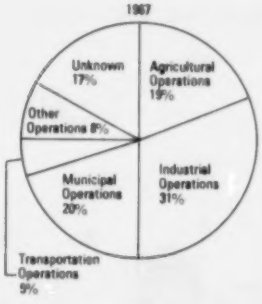


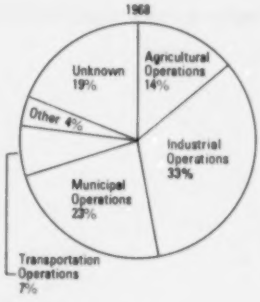


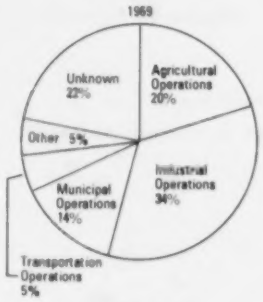


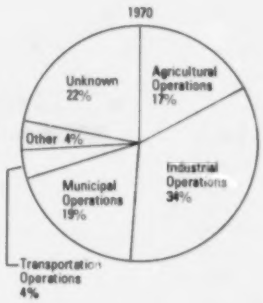


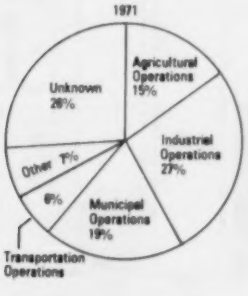


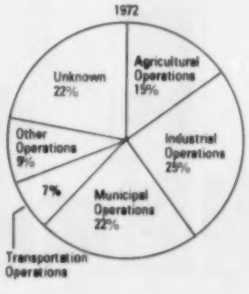


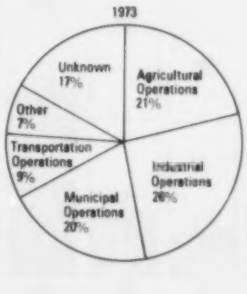


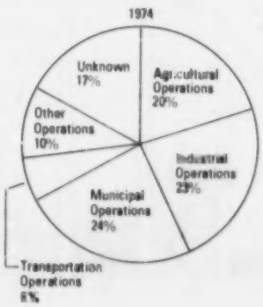


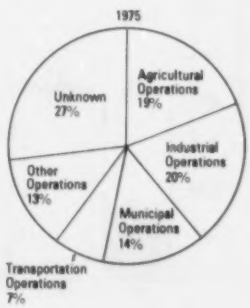












* The transportation operations category was not included in reports for 1961 and 1962.

Agricultural and municipal operations were the next most common causes of fish kills, with each accounting for 18 percent of the reported incidents.

Transportation operations accounted for 5 percent of the reported incidents over the fifteen-year period, while other operations accounted for 8 percent of the incidents. In 19 percent of the incidents, the cause of the kill was not known.

In 1974, 47 million fish were killed in one incident in Back River, near Essex, Maryland eclipsing the previous high for one incident which was 37.8 million reported in a single kill in 1962 near San Diego Harbor, California. Three other 1974 incidents in Back River caused kills of 31.9, 11.0, and 10.7 million fish. More fish were reported killed in each of these incidents than in any other single incident with one exception: An incident in Lake Thonotossassa, Florida in 1969 in which 26.5 million fish were killed.

Although kills of over 1,000,000 fish accounted for only one percent of the incidents, these incidents accounted for 77 percent of the fish reported killed during the 15-year period (Table 2). The largest percentage of the reports submitted (39 percent) were within the 0 to 1,000 range of fish killed. This range had the lowest percentage of fish reported killed (0.2 percent).

Table 2—Number and Percent of Reports, and Fish Killed by Size of Kill, 1961-1975

Range	Number of reports	Percent of reports	Number of fish killed (millions)	Percent of fish killed
1,000,000, or more	79	1	360.10	77.4
100,000 to 1,000,000	254	3	65.24	14.0
10,000 to 100,000	1,070	12	30.51	6.7
1,000 to 10,000	2,838	29	8.19	1.7
0 to 1,000	3,457	39	0.81	0.2
No size reported for incident	1,469	16		
Total	8,967	100	464.85*	100

* Rounding off accounts for the difference in the total number of fish killed (465,449,000) as reported in Table 1.

Table 2 summarizes the number and percent of reports and fish killed by size of kill. The one percent of the reports in the million or more fish killed range accounted for 77 percent of the fish reported killed between 1961 and 1975.

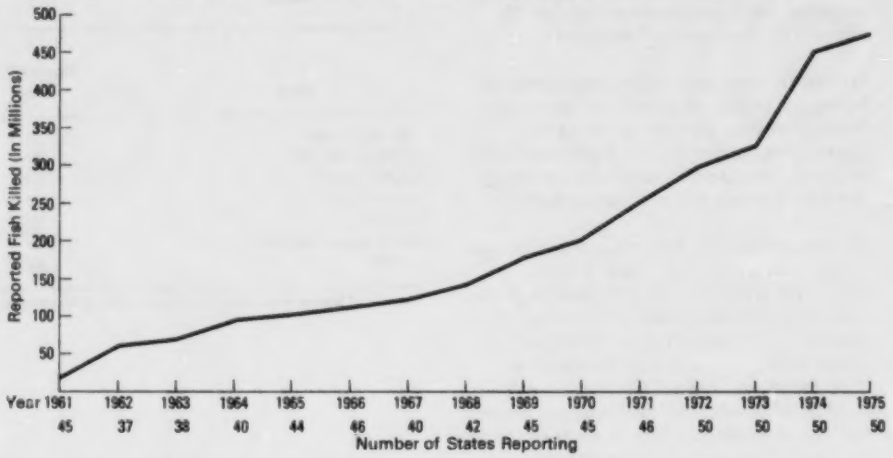
Industrial Operations had the highest percentage of reported fish kill incidents (32 percent) during the 15-year reporting period (Figure 2).

Total Fish Reported Killed

A total of 465.4 million fish were reported killed (Figure 3) in 7,492 separate incidents of water pollution from all sources (Table 3, Figure 4). During the fifteen-year period (1961–1975) the largest number of fish kills reported in the United States were classified as municipal operations (42 percent), with sewerage systems being the major municipal operation causing fish kills (Figure 5). Industrial operations ranked second (21 percent) in the number of reported fish kills; unknown causes ranked third (18 percent), other operations ranked fourth (12 percent), agricultural operations ranked fifth (6 percent) and transportation operations ranked sixth and last with one percent. In the remaining 1,475 reports (16 percent), fish losses were either not stated, or were not expressed in numerical terms.

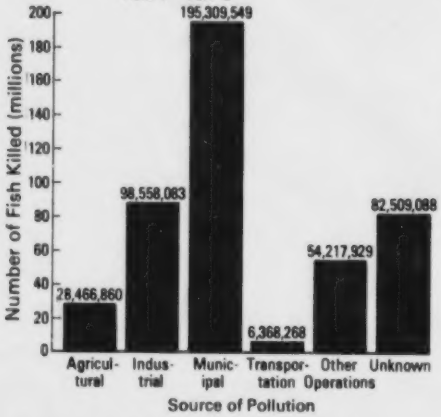
Of the 465.4 million fish killed (Table 4), 422.7 million (90 percent) were classified as non-game fish* and 10 percent were classified as game fish.

Figure 3—Cumulative Reported Fish Killed, 1961–1975



Over 465 million fish were reported killed by pollution during the 15-year period. Figure 3 summarizes the reported number of fish killed for the 1961–1975 period. The first reporting year, 1960 was excluded since reports were not received for the full year.

Figure 4—Number of Fish Killed, by Source of Pollution, 1961–1975



Municipal operations killed more fish (195 million) than any other operational source of pollution (Figure 4).

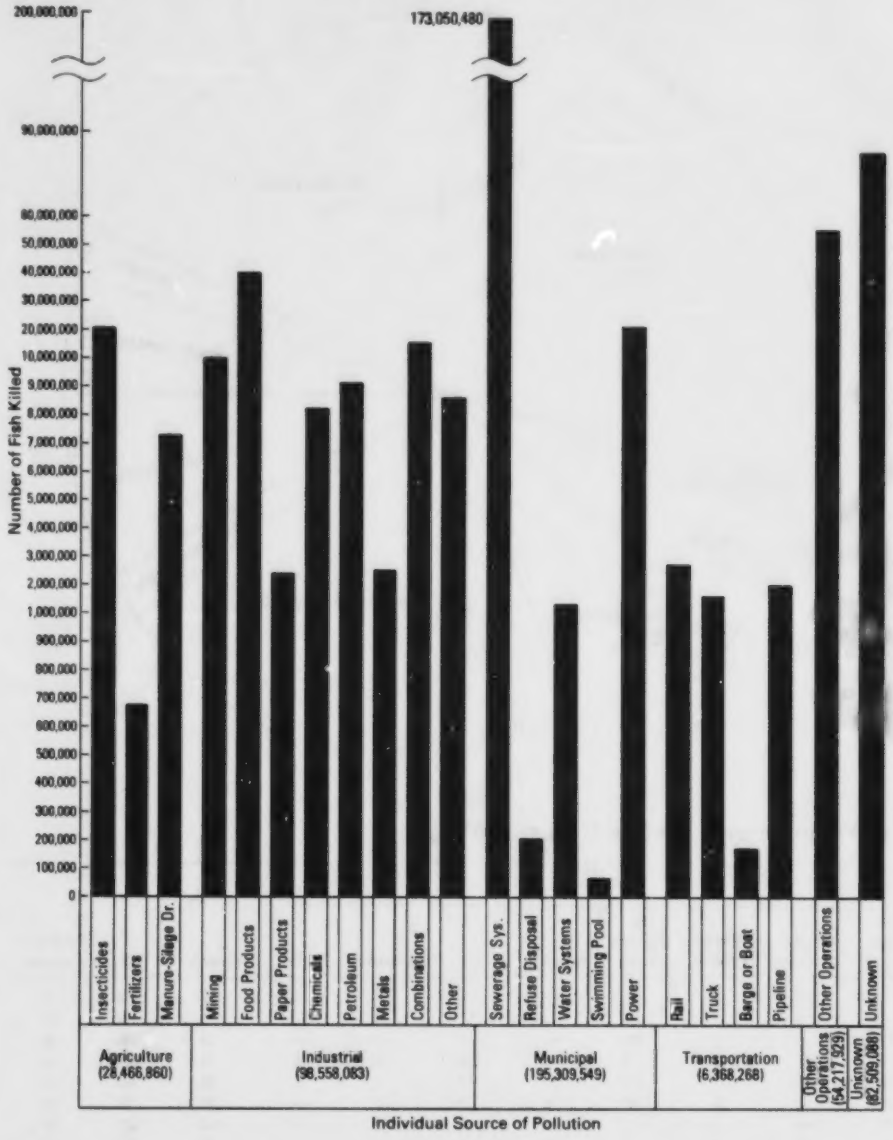
Table 3 Summarizes fish kills by major and individual sources of pollution. Municipal operations was the leading source of pollution, accounting for 42 percent of the fish reported killed.

* Non-game fish generally have no limitations as to size, weight, season or type of lure.

Table 3—Fish Kill Summary by Source of Pollution, 1961-1975

Source of pollution	Reports specifying number of fish killed: Total reports	Number of reports	Number of fish killed	Percent fish killed, by source of pollution
Agricultural				
Insecticides	1,024	813	20,569,419	
Fertilizers	97	85	670,334	
Manure-silage drainage	480	424	7,227,107	
Subtotal	1,601	1,322	28,466,860	6%
Industrial				
Mining	376	297	9,937,230	
Food products	441	362	42,947,899	
Paper products	137	115	2,336,902	
Chemicals	503	444	8,203,552	
Petroleum	321	245	9,089,513	
Metals	211	188	2,512,078	
Combinations	93	84	15,000,643	
Other	763	603	8,530,266	
Subtotal	2,845	2,338	98,558,083	21%
Municipal				
Sewerage systems	1,340	1,144	173,050,480	
Refuse disposal	45	39	211,788	
Water systems	111	102	1,224,543	
Swimming pool	44	42	67,830	
Power	90	80	20,752,255	
Subtotal	1,630	1,407	195,309,549	42%
Transportation				
Rail	85	71	2,697,202	
Truck	220	210	1,581,138	
Barge or boat	32	26	167,519	
Pipeline	143	119	1,922,409	
Subtotal	480	426	6,368,268	1%
Other operations	673	537	54,217,929	12%
Unknown	1,738	1,462	82,509,088	18%
Total	8,967	7,492	465,429,777	100%

Figure 5—Number of Fish Killed, by Individual Source of Pollution, 1961–1975



Sewerage systems under municipal operations led all other individual sources of pollution (Figure 5) in the number of fish killed (173 million).

Table 4—Summary of Game and Nongame Fish Killed, 1961-1975

Source of Pollution	Total reports	Percent of reports	Reports specifying reported fish kill: No. of reports	Reports specifying reported fish kill: No. of fish	Percent of fish killed	Estimated fish killed: Game	Estimated fish killed: Nongame
Agricultural	1,601	18	1,322	28,466,860	6	5,395,970	24,252,225
Industrial	2,845	32	2,338	98,558,083	21	14,790,568	85,145,713
Municipal	1,630	18	1,407	195,309,549	42	5,992,861	187,325,269
Transportation	480	5	426	6,368,268	1	1,369,445	5,246,236
Other	673	8	537	54,217,929	12	8,343,618	45,486,179
Unknown	1,738	19	1,462	82,509,088	18	6,812,786	75,268,763
Total	8,967	100	7,492	465,429,777	100	42,705,228	422,274,385

Table 4 summarizes the number of fish killed during the 1961–1975 period by major sources of pollution. This table also summarizes the number of fish killed in the game and nongame categories.

Water Quality Changes Associated with Fish Kill Incidents

The conditions previously described lead to specific changes in the water conditions which cause the fish kills. These specific causes were identified for 8,967 kills over the 15-year period.

Low dissolved oxygen (Table 5, Figure 6) was the leading known specific cause of fish kills, resulting in 1,893 incidents (21 percent). Pesticides ranked second as a known cause of reported fish kills (18 percent), while petroleum and inorganic chemicals ranked third (8 percent). Acids and organic chemicals ranked fourth (5 percent each), followed by fertilizers and mixed chemicals (2 percent each), and thermal and combinations (1 percent each). The specific cause was not known for 29 percent of all reported fish kill incidents.

Low dissolved oxygen was the leading specific cause of reported fish kills (21 percent, Figure 6).

Table 5 summarizes fish kill reports by individual sources of pollution and specific causes during the 15-year reporting period.

Figure 6—Summary of Reported Fish Kill Incidents by Specific Cause, 1961–1975

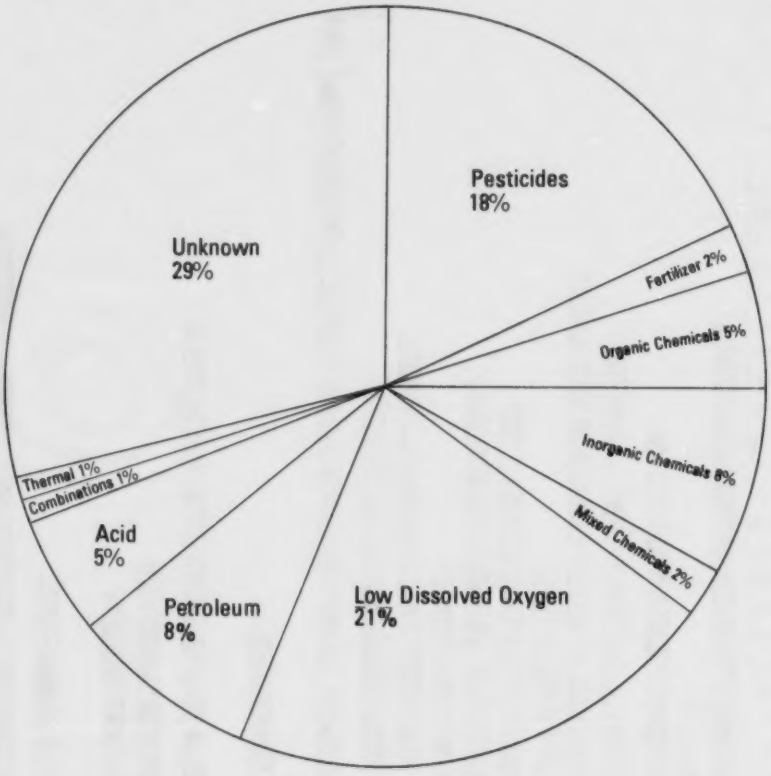


Table 5—Fish Kill Reports, by Source of Pollution and Specific Cause, 1961-1975

Individual sources of pollution	Specific Cause												
	Pesticides and poisons	Fertilizers	Organic chemicals	Inorganic chemicals	Mixed chemicals	Low dissolved oxygen	Petroleum	pH	Combination	Thermal	Unknown	Total	Percent of reports
Pesticides	921	--	2	12	1	--	--	--	1	--	87	1,024	11
Fertilizers	--	76	--	9	--	6	--	1	1	--	4	97	01
Feed lot drainage	2	--	11	5	1	407	--	6	9	--	39	480	05
Mining	30	--	7	25	18	5	5	200	8	2	76	376	04
Food and kindred products	5	--	58	42	11	227	7	16	4	2	68	440	05
Paper and allied products	--	--	12	14	22	48	5	5	2	--	29	137	02
Chemicals	19	21	71	132	33	25	2	45	7	4	143	502	06
Petroleum	--	--	7	15	8	4	215	26	6	--	39	320	04
Metals	1		2	92	11	--	8	32	6		59	211	02
Combination	--	--	2	4		25	2	1	22	1	36	93	01
Other industrial	215	5	75	57	12	61	42	40	12	7	237	763	09
Sewerage system	96	5	121	74	9	821	8	15	17	2	169	1,337	15
Refuse disposal	2	1	6	5	2	14	--	2	3	--	10	45	--
Water system	14	--	2	58	13	4	--	6	--	1	13	111	01
Swimming pool	1	--	1	37	--	--	--	3	--	--	2	44	--
Power	4		2	12	2	13	9	3	1	27	17	90	01
Rail	6	3	9	11	2	3	33	6	1	--	11	85	01
Truck	6	14	22	24	7	1	112	15	2	--	17	220	02
Barge or boat	--	--	1	1	--	5	19	1	--	--	5	32	--
Pipeline	1	2	2	3	1	3	117	2	1	--	11	143	02
Other	191	1	37	62	43	102	76	28	11	4	123	678	08
Unknown	58	8	8	30	10	120	20	17	12	--	1,454	1,737	20
Total	1,572	136	458	724	206	1,894	680	470	126	50	2,651	8,967	100%
Percent of reports	18%	2%	5%	8%	2%	21%	8%	5%	1%	1%	29%		100%

Major Fish Kills

Between 1961 and 1975, a total of 425 million fish were reported killed in 333 incidents which involved more than 100,000 fish killed in each incident (Table 6). Industrial operations accounted for the greatest number of incidents (105 reports or 32 percent), while municipal operations accounted for the greatest number of fish killed (187 million or 43 percent). Sewerage systems led all individual sources of pollution in the number of major fish kill reports (82 reports or 24.6 percent), and in the number and percent of fish killed (166 million, 39 percent).

Seventy-seven of these major incidents involved a million or more fish each and accounted for a total of 382 million dead fish within 21 States and the District of Columbia (Table 7). The States of Alabama, Florida, and Texas (Figure 7) reported the largest number of individual fish kills of one million or more fish. Alabama submitted nine of these reports totaling 15 million fish, with sewerage systems causing six incidents involving 12 million fish. Four of these large kills, totaling 7,000,000 fish, occurred near Mobile, Alabama.

Table 6—Major Fish Kills (100,000 or Over)

Source of pollution	Total reports	Percent reports	Number of fish	Percent fish killed
Agricultural:				
Insecticides	17	5.1	15,769,517	3.7
Fertilizers	1	0.3	105,834	0.0
Manure-silage drainage	18	5.4	4,762,131	1.1
Subtotal	36	10.8	20,637,482	4.8
Industrial:				
Mining	16	4.8	7,524,019	1.8
Food products	13	3.9	40,773,402	9.6
Paper products	6	1.8	1,886,068	0.5
Chemicals	22	6.6	5,461,086	1.3
Petroleum	13	3.9	7,948,423	1.9
Metals	8	2.4	1,587,622	0.4
Combinations	10	3.0	14,645,330	3.3
Other	17	5.1	4,982,485	1.1
Subtotal	105	31.5	84,808,435	19.9
Municipal:				
Sewerage systems	82	24.6	166,046,754	39.00
Refuse disposal	—	—	—	—
Water systems	3	1.0	969,600	0.2
Swimming pool	—	—	—	—
Power	11	3.3	20,173,380	4.7
Subtotal	96	28.9	187,189,734	43.9
Transportation:				
Rail	4	1.20	2,030,000	0.4
Truck	3	.90	442,244	0.1
Barge or boat	—	—	—	—
Pipeline	6	1.80	1,120,760	0.3
Subtotal	13	3.90	3,593,004	0.8
Other operations	22	6.6	52,131,382	12.2
Unknown	61	18.3	77,410,167	18.1
Total	333	100.0	425,770,204	100.00

Table 6 lists the major fish kill incidents occurring between 1961 and 1975 in which 100,000 or more fish were killed in each incident. Industrial operations accounted for the greatest number of incidents (105 reports or 31.5 percent), while municipal operations accounted for the greatest number of fish killed (187 million fish, or 43 percent).

Table 7—Fish Kills Totaling 1,000,000 or Over, 1961-1975

Year	State	Number of fish killed	Near or in	Lake or stream	Operation
1968	Alabama	1,000,000	Mobile	Dog River	Sewerage system
1968	Alabama	1,000,000	Fackler	Mud Creek	Rail transportation
1970	Alabama	3,000,000	Mobile	Dog River	Sewerage system
1971	Alabama	1,000,000	Birmingport	Locust Fork	Combination
1971	Alabama	2,000,000	Gilmore	Valley Creek	Sewerage system
1971	Alabama	2,000,000	Mobile	Eslava Creek-Dog River	Sewerage system
1972	Alabama	1,000,000	Josephine	Soldier Creek	Unknown
1972	Alabama	1,000,000	Mobile	Three Mile Creek	Sewerage system
1974	Alabama	3,000,000	Birmingport	Locust Fork	Sewerage system
1962	California	37,000,000	San Diego	Coastal Waters	Other operations
1964	California	2,000,000	Santa Barbara	Santa Barbara Harbor	Sewerage system
1970	California	2,000,000	Los Bands	Delta Mendota Canal	Food products
1965	Connecticut	3,000,000	Wethersfield	Wethersfield Covert.	Sewerage system
1971	Connecticut	1,000,000	Norwich	Thames River	Sewerage system
1971	Connecticut	2,000,000	Waterford	Millstone Point	Power
1962	District of Columia	3,000,000	District of Columbia	Anacostia River	Sewerage system
1964	Florida	1,000,000	Sanford	Lake Jessup	Sewerage system
1966	Florida	1,000,000	Winter Garden	Lake Apopka	Other operations
1969	Florida	26,000,000	Plant City	Lake Thonotossassa	Food products
1971	Florida	3,000,000	Santa Rosa County	Bass Hole Cove	Unknown
1971	Florida	5,000,000	Santa Rosa County	F. Shore FS Cambia	Unknown
1971	Florida	2,000,000	Santa Rosa County	Saltzman Bayou	Unknown
1971	Florida	2,000,000	Santa Rosa County	Judges Bayou-ESC	Unknown
1971	Florida	2,000,000	Santa Rosa County	Judges Bayou-ESC	Unknown
1971	Florida	2,000,000	Santa Rosa County	Bass Hole Cove	Unknown
1971	Florida	2,000,000	Santa Rosa County	Judges Bayou	Unknown
1971	Florida	2,000,000	Santa Rosa County	Judges Bayou	Unknown
1971	Florida	2,000,000	Santa Rosa County	Mulatto Bayou	Unknown
1971	Florida	2,000,000	Santa Rosa County	N. Escambia Bay	Unknown
1971	Florida	2,000,000	Santa Rosa County	Mulatto Bayou	Unknown
1971	Florida	2,000,000	Santa Rosa County	Mulatto Bayou-Canal	Unknown
1970	Georgia	2,000,000	Augusta	Camille or Lakes	Sewerage system
1963	Hawaii	2,000,000	Wahiawa Oahu	Wahiawa Reservoir	Unknown
1961	Illinois	5,000,000	Creve Couer	Illinois River	Poisons
1967	Iowa	6,000,000	Webster City	Boone River	Food products
1968	Iowa	1,000,000	Des Moines	Des Moines River	Sewerage system
1971	Louisiana	1,000,000	Slidell	Salt Bayou	Sewerage system
1971	Maryland	1,000,000	Conowingo	Susquehanna River	Power
1974	Maryland	47,000,000	Essex	Back River	Sewerage system
1974	Maryland	10,000,000	Essex	Back River	Sewerage system
1974	Maryland	11,000,000	Essex	Back River	Sewerage system
1974	Maryland	31,000,000	Essex	Back River	Sewerage system
1971	Massachusetts	1,000,000	Somerset	Lee River	Chemicals
1972	Massachusetts	1,000,000	Falmouth	Great Pond	Poisons
1972	Massachusetts	1,000,000	Sandwich	Cape Cod Canal	Power
1971	New Jersey	2,000,000	Goshen	Biswell Ditch	Other operations
1973	New Jersey	1,000,000	Waretown	Oyster Creek	Power
1961	North Carolina	5,000,000	Cherry Point	Slocum Creek	Unknown
1964	Ohio	7,000,000	New Miami	Great Miami River	Combination
1965	Ohio	1,000,000	Hancock County	Blanchard River	Sewerage system
1972	Ohio	2,000,000	Lake County	Lake Erie	Power
1974	Ohio	2,000,000	Hancock County	Radar Creek	Food products
1965	Oklahoma	1,000,000	Waukomis	Big Turkey Creek	Petroleum
1961	Pennsylvania	1,000,000	Sunbury	Susquehanna River	Mining
1964	Pennsylvania	1,000,000	Slippery Rock	Slippery Rock Creek	Mining
1966	Pennsylvania	1,000,000	Sharsbury	Allegheny River	Mining
1968	Pennsylvania	4,000,000	Bruin	Allegheny River	Petroleum
1961	Tennessee	1,000,000	Johnson City	Boone River	Other industrial
1969	Tennessee	2,000,000	Johnson City	Boone Lake	Other operations
1969	Texas	5,000,000	Brownsville	Arroyo Colorado	Poisons
1970	Texas	2,000,000	Channelview	San Jacinto River	Combination
1970	Texas	1,000,000	Freeport	Freeport Harbor	Unknown
1971	Texas	1,000,000	Anahucac	Oyster Bayou	Unknown
1971	Texas	3,000,000	Anahucac	Trinity River	Sewerage system
1971	Texas	2,000,000	Dickinson	Dickinson Bayou	Sewerage system
1971	Texas	3,000,000	Dickinson	Dickinson Bayou	Sewerage system
1971	Texas	4,000,000	Dickinson	Dickinson Bayou	Sewerage system
1971	Texas	1,000,000	Gilcrist	Sun Oil "Slip"	Unknown

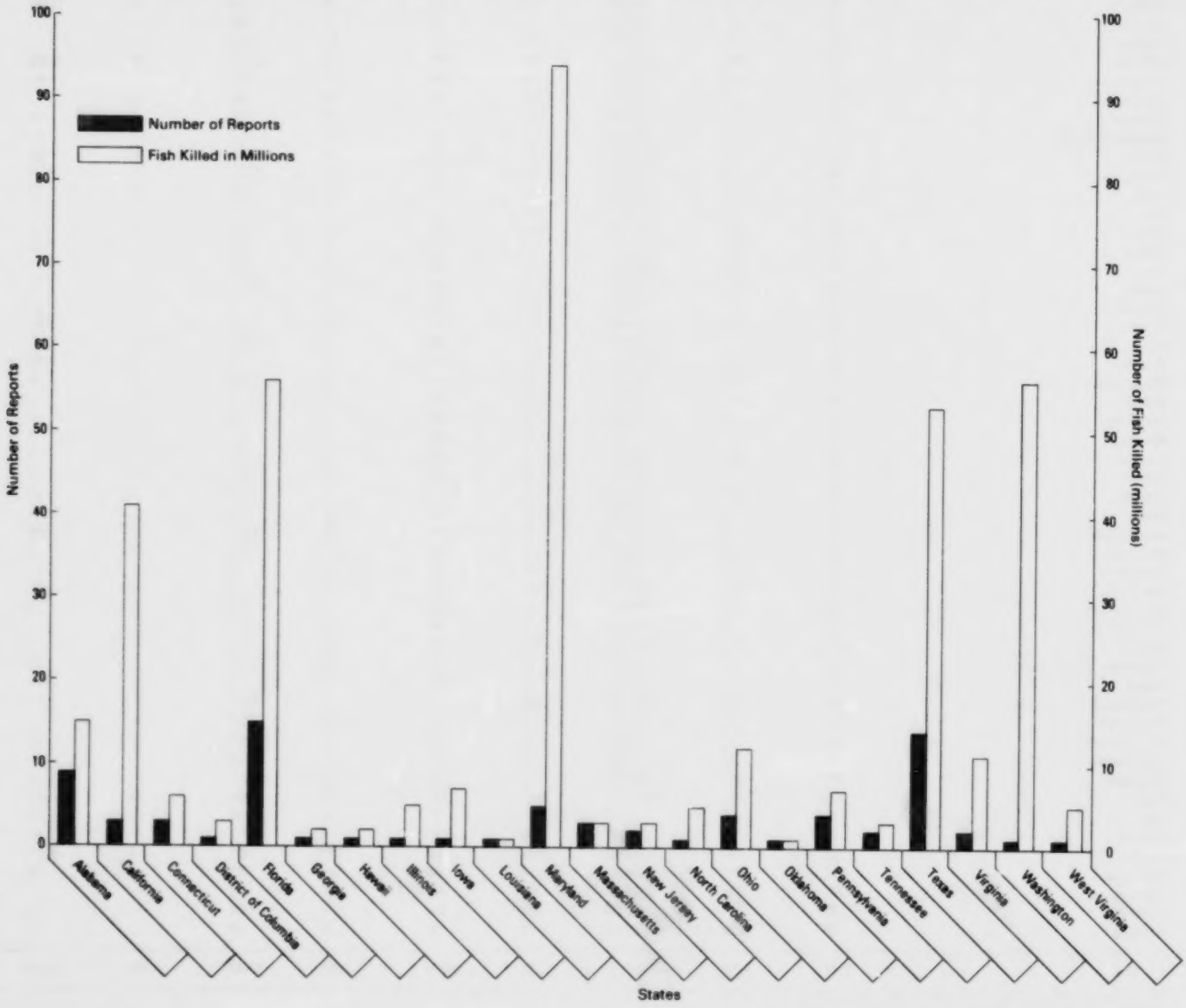
Table 7 lists the major fish kill incidents occurring between 1961 and 1975 in which 1,000,000 or more fish were killed in each incident. These kills are listed by: Year; State; number of fish killed; name of nearest town or county; receiving water; and operations. A total of 382,000,000 fish were reported killed in 77 incidents.

Table 7—*Continued*

Year	State	Number of fish killed	Near or in	Lake or stream	Operation
1972	Texas	1,000,000	Houston	Galveston Bay	Combination
1973	Texas	1,000,000	Galveston	Gulf of Mexico	Unknown
1973	Texas	3,000,000	Galveston	Gulf of Mexico	Unknown
1973	Texas	10,000,000	Houston	Drainage Canals	Unknown
1973	Texas	6,000,000	Laporte	Taylor Lake	Unknown
1964	Virginia	4,000,000	Jamestown	James River	Unknown
1973	Virginia	7,000,000	Menchville	James River	Unknown
1971	Washington	56,000,000	Pasco	Snake River	Other operations
1960	West Virginia	5,000,000	Charleston	Kanawha River	Other industrial
	Total	382,000,000			

Florida and Texas ranked first and second, respectively, in the number of reports involving a million or more fish killed (Figure 7). Maryland ranked first in the number of fish killed in the 1,000,000 or more range, followed by Florida and Washington.

Figure 7—Number of Fish Killed (1,000,000 or More) Reported in 21 States and the District of Columbia, 1961–1975



Fish Kills, by Type of Water Body

Of the 8,967 fish kill incidents between 1961 and 1975 (Table 8), 7,253 (81 percent) occurred in rivers, 1,424 (16 percent) occurred in lakes, and 290 (3 percent) occurred in coastal waters (Figure 8).

A total of 213.5 million fish were killed in rivers, accounting for 46 percent of the fish reported killed between 1961 and 1975 (Figure 9). Fish killed in lakes (61 million) accounted for 13 percent of fish reported killed, and the fish killed in coastal waters (190.8 million) accounted for 41 percent of the fish reported killed during the 15-year summary period.

Therefore, the kills in coastal waters were, on the average, much larger than the kills in rivers and streams.

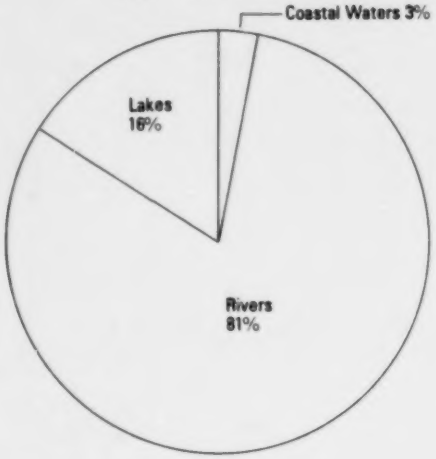
Ohio led in the number of incidents reported in rivers (985), Florida led in the number of incidents reported on lakes (130), and California led in the number of incidents (91) reported in coastal waters (Figure 10).

Table 8—Pollution-Caused Fish Kills, by State and Type of Water Body, 1961-1975

State	Total reports	Reports specifying number of fish killed		River		Lake		Coastal waters*	
		Number of reports	Number of fish	Number of reports	Number of miles	Number of reports	Number of acres	Number of reports	Number of miles
Alabama	271	251	31,757,304	220	6,343	44	4,988	7	8
Alaska	15	10	580,885	5	34	4	1,294	6	11,522
Arizona	13	11	612,817	11	92	2	154	--	--
Arkansas	122	47	479,649	61	674	61	7,969	--	--
California	486	460	48,605,273	289	601	106	36,212	91	34,863
Colorado	34	28	1,498,991	28	142	6	81	--	--
Connecticut	145	107	6,628,684	104	251	36	852	5	1
Delaware	22	17	33,656	14	24	5	60	3	23
District of Columbia	3	2	3,680,000	3	3	--	--	--	--
Florida	262	194	62,196,908	83	707	130	39,280	49	969
Georgia	144	74	2,317,906	80	539	63	8,863	1	--
Hawaii	47	41	2,300,434	28	29	8	308	11	53
Idaho	48	47	1,746,917	41	151	7	1,391	--	--
Illinois	269	259	11,797,864	241	1,360	28	3,398	--	--
Indiana	270	208	630,414	259	801	11	51	--	--
Iowa	123	93	8,833,227	111	627	12	41	--	--
Kansas	203	194	5,864,076	183	1,114	20	22,131	--	--
Kentucky	122	77	1,771,779	117	709	5	7	--	--
Louisiana	268	212	2,427,802	241	1,764	26	2,446	1	1,000
Maine	65	37	93,655	57	165	8	3,396	--	--
Maryland	69	57	104,086,625	48	1,289	8	49	13	2,269
Massachusetts	97	84	4,243,293	53	141	42	1,108	2	67
Michigan	125	109	352,087	105	152	20	24	--	--
Minnesota	79	48	83,324	72	1,206	7	30	--	--
Mississippi	24	21	421,930	20	1,506	3	51	1	5
Missouri	383	325	3,625,737	315	1,436	68	690	--	--
Montana	52	35	450,468	48	324	4	855	--	--
Nebraska	159	125	1,406,630	95	424	64	3,254	--	--
Nevada	12	7	45,500	10	30	2	251	--	--
New Hampshire	72	42	161,338	36	40,132	35	8,350	1	700
New Jersey	370	332	5,168,431	243	436	121	1,263	6	9
New Mexico	17	11	31,375	15	127	2	38	--	--
New York	376	335	2,369,816	349	772	25	76	2	100
North Carolina	149	136	6,632,476	122	1,594	24	589	3	1
North Dakota	27	23	603,500	11	354	16	4,107	--	--
Ohio	1,011	956	24,342,738	985	190	26	--	--	--
Oklahoma	93	71	2,626,507	68	510	25	4,006	--	--
Oregon	114	90	938,573	93	10,287	21	77	--	--
Pennsylvania	983	900	16,034,493	940	2,781	43	4,573	--	--
Rhode Island	22	19	46,250	7	31	15	512	--	--
South Carolina	35	30	388,883	29	207	6	435	--	--
South Dakota	21	16	549,697	14	184	7	3,088	--	--
Tennessee	254	222	8,060,063	209	726	45	2,075	--	--
Texas	779	535	66,863,777	589	1,797	118	2,196	72	271
Utah	31	24	71,223	23	92	8	33	--	--
Vermont	19	16	75,595	19	73	--	--	--	--
Virginia	188	167	13,043,962	150	633	33	253	5	38,419
Washington	221	159	6,464,258	172	369	38	115	11	35
West Virginia	147	136	1,739,137	145	614	2	9	--	--
Wisconsin	77	71	560,036	69	243	8	399	--	--
Wyoming	29	21	83,814	23	79	6	59	--	--
Total	8,967	7,492	465,429,777	7,253	84,869	1,424	171,487	290	90,315

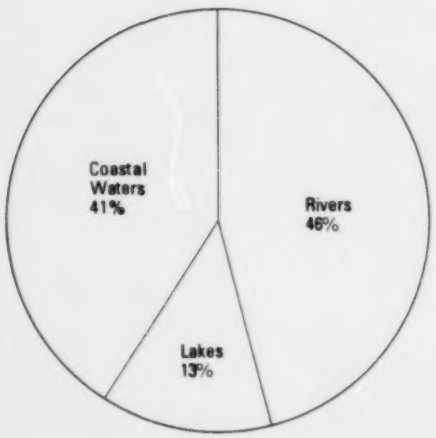
* Includes embayments such as Chesapeake, San Francisco, and Galeston Bays.

Figure 8—Summary of Pollution-Caused Fish Kill Reports, by Type of Water Body, 1961–1975



Of the three water bodies affected by pollution, rivers (Figure 8) had the highest percentage of reported fish kills (81 percent), followed by lakes (16 percent) and coastal waters (3 percent).

Figure 9—Summary of Fish Killed, by Type of Water Body, 1961–1975.



Of the three types of water bodies affected by pollution, rivers led in the number of reported fish killed (46 percent) followed by coastal waters (41 percent) and lakes (13 percent) (Figure 9).

Table 8 summarizes data from the 50 States which reported one or more pollution-caused fish kill incidents. Of the 8,967 reports submitted, 7,492 indicated the number of fish killed. The remaining 1,475 reports did not specify the number of fish killed. The table also shows the number of reports for incidents that occurred in rivers, lakes, and coastal waters and the areas affected.

Figure 10—Number of Fish Kill Reports, by State and Water Bodies Affected, 1961–1975

Ohio reported the largest number of fish kill incidents occurring in rivers (985 reports) while Florida (Figure 10) reported the largest number of incidents occurring in lakes (130 reports). California led all other States in the number of incidents occurring in coastal waters (91 reports).

Fish Kills, by Month

The greatest number of reports (5,375 or 60 percent of the total number of reports) were submitted for the warm weather months of June, July, August, and September (Table 9). In terms of fish killed, August ranked first with 195 million, or 42 percent of all fish killed during the 1961–1975 period, followed by July and September with approximately 70 million fish (15 percent) each. The smallest number of fish were killed in February and December (two and three million, respectively).

Table 9—Fish Kill Summary by Month, 1961-1975

Month	Total reports	Reports specifying number of fish killed	
		Number of reports	Number of fish
January	282	217	36,170,813
February	266	203	2,013,645
March	389	312	5,855,159
April	617	503	12,066,295
May	940	771	24,930,321
June	1,226	1,052	13,080,057
July	1,556	1,317	69,320,514
August	1,467	1,249	195,268,725
September	1,126	954	70,798,407
October	607	510	27,035,440
November	336	279	5,798,355
December	155	125	3,092,046
Total	8,967	7,492	465,429,777

Table 9 summarizes fish kills occurring by month during the 15-year reporting period.

Five-Year Summary of Fish Kill Reports, by Sources of Pollution in Ten EPA Regions, 1971–1975

Table 10 summarizes the fish kill incidents by pollution source operations within each Environmental Protection Agency Region for the 1971–1975 period. Figure 11 is a national map that outlines the EPA regional boundaries and the States and territories that make up each region.

The variations between EPA regions reflect the characteristics of the regions. For example, industrial operations, led by the chemical, petroleum and mining industries were by far the major cause of fish kills in Region III, which includes the heavily industralized areas along the lower Delaware River and near Pittsburgh, as well as the Appalachian coal mining areas in Maryland, Pennsylvania, and West Virginia. On the other hand, agricultural operations were the major cause of fish kills in Regions VII and VIII, which include much of the nation's farm belt.

Table 10—Percentage of Fish Kill Reports by Source of Pollution Within EPA Regions, Five-Year Summary, 1971-1975*

Source of pollution:	EPA Regions I	II	III	IV	V	VI	VII	VIII	IX	X	Total	Percent
Agricultural:												
Pesticides	23	11	19	102	24	93	23	9	51	20	375	10.1
Fertilizers	--	2	3	5	27	2	14	2	1	7	63	1.7
Manure-silage drainage	2	5	25	22	92	14	50	12	3	6	231	6.2
Subtotal	25	18	47	129	143	109	87	23	55	33	669	
Percent	18.2	5.9	7.0	19.4	18.2	22.1	28.0	30.7	22.4	18.5	18.0	18.0
Industrial:												
Mining	--	4	32	25	20	2	21	6	13	2	125	3.4
Food products	--	28	13	10	45	10	10	2	4	5	127	3.4
Paper products	2	1	2	20	10	5	3	--	--	5	48	1.3
Chemicals	15	23	49	38	28	30	12	1	4	4	204	5.5
Petroleum	1	9	46	9	20	33	12	--	2	5	137	3.7
Metals	1	11	20	9	13	6	4	2	1	3	70	1.9
Combinations	1	--	4	3	2	13	--	--	--	--	23	0.6
Other	7	11	37	27	50	13	4	2	7	14	172	4.6
Subtotal	27	87	203	141	188	112	66	13	31	38	906	
Percent	19.8	28.6	38.9	21.2	23.9	22.7	21.2	17.3	12.7	21.4	24.4	24.4
Municipal:												
Sewerage systems	15	49	60	135	157	80	51	14	22	8	591	16.0
Refuse disposal	--	5	6	2	6	1	2	--	--	--	22	0.6
Water systems	2	6	9	8	8	2	2	2	8	3	50	1.3
Swimming pool	2	4	5	1	--	--	--	2	2	--	16	0.4
Power	7	11	8	1	15	1	8	--	1	3		
Subtotal	26	75	88	147	186	84	63	18	33	14	734	
Percent	19.0	24.7	16.9	22.1	23.7	17.0	20.3	24.0	13.5	7.9	19.8	19.8
Transportation:												
Rail	1	1	5	3	7	5	6	2	2	1	33	0.9
Truck	3	23	48	16	22	6	9	3	10	5	145	3.9
Barge or boat	--	--	2	1	--	3	--	--	--	1	7	0.2
Pipeline	1	1	20	3	22	9	15	1	3	--	75	2.0
Subtotal	5	25	75	23	51	23	30	6	15	7	260	
Percent	3.6	8.2	14.3	3.5	6.5	4.7	9.6	8.0	6.1	3.9	7.0	7.0
Other Operations:	17	41	70	37	61	40	18	5	27	28	344	
Percent	12.4	13.5	13.4	5.6	7.8	8.1	5.8	6.7	11.0	15.7	9.2	9.2
Unknown:	37	58	39	187	156	125	47	10	84	58	801	
Percent	27.0	19.1	7.5	28.2	19.9	25.4	15.1	13.3	34.3	32.6	21.6	21.6
Total:	137	304	522	664	785	493	311	75	245	178	3,714	
Percent	100	100	100	100	100	100	100	100	100	100	100	100

REGION I
Connecticut
Maine
Massachusetts
New Hampshire
Rhode Island
Vermont

REGION II
New Jersey
New York

REGION III
Delaware
District of Columbia
Maryland
Pennsylvania
Virginia
West Virginia

REGION IV
Alabama
Florida
Georgia
Kentucky
Mississippi
North Carolina
South Carolina
Tennessee

REGION V
Illinois
Indiana
Michigan
Minnesota
Ohio
Wisconsin

REGION VI
Arkansas
Louisiana
New Mexico
Oklahoma
Texas

REGION VII
Iowa
Kansas
Missouri
Nebraska

REGION VIII
Colorado
Montana
North Dakota
South Dakota
Utah
Wyoming

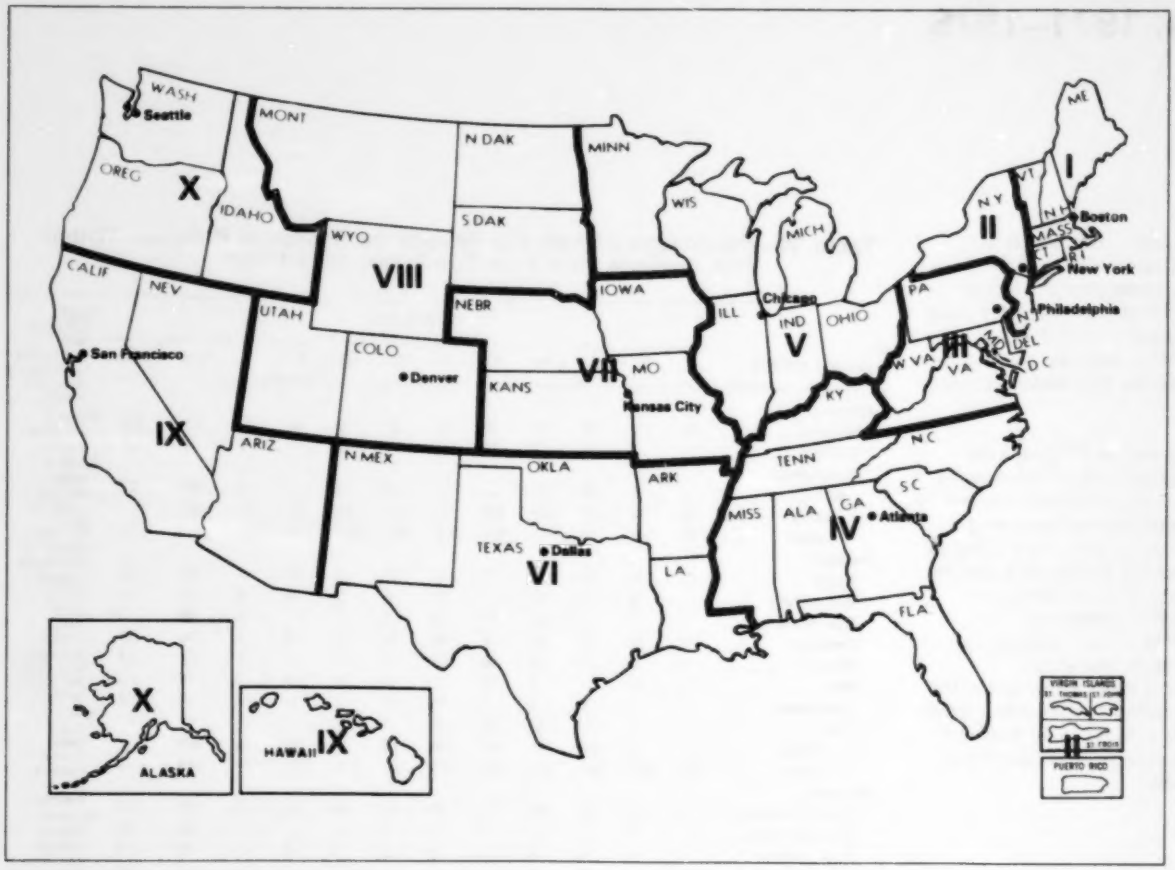
REGION IX
Arizona
California
Hawaii
Nevada

REGION X
Alaska
Idaho
Oregon
Washington

* Present EPA regions were established in 1971.

Table 10 summarizes the number of reported pollution-caused fish kill incidents by individual sources of pollution for each EPA region.

Figure 11—National Map Showing EPA Regional Boundaries



The 10 U.S. Environmental Protection Agency regional boundaries are displayed on a national map (Figure 11).

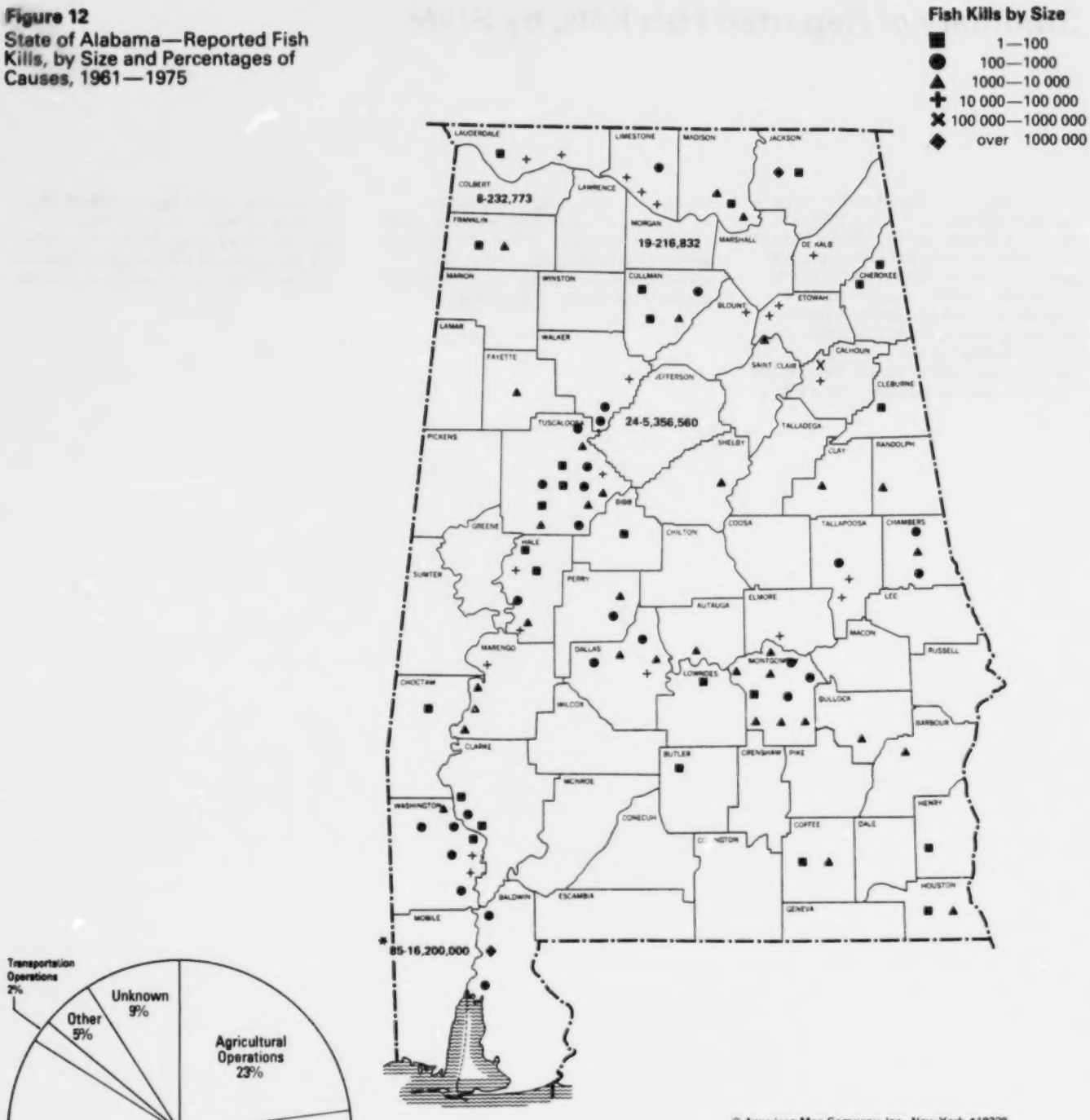
Summary of Reported Fish Kills, by State

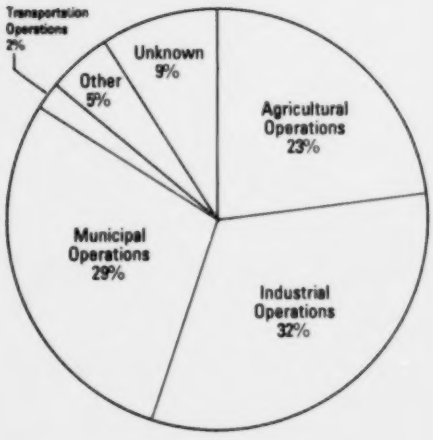
This section of the report summarizes fish kills reported during the 1961–1975 period on a State-by-State basis. Data for each State are reported separately and each reported fish kill is located within the county in which it occurred. Each map includes a set of symbols denoting the size of an individual kill. When map scale prohibits the use of symbols, numbers are used to denote the number of reports and the number of fish killed.

Figures 12 through 62 which follow consist of individual State maps showing the location and size of fish kills reported within specific counties, and a chart showing the percentage of fish killed, by source of pollution, in each State.

The counties which reported fish kills in the State of Texas are shown in a separate listing which follows Figure 56. This listing shows the number of reports and the number of fish killed, by county.

Figure 12
State of Alabama—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975





* Indicates the number of reports and the number of fish killed.

Figure 13
State of Alaska—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

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Figure 14
State of Arizona—Reported Fish Kills, by Size and Percentages of Causes, 1961–1975

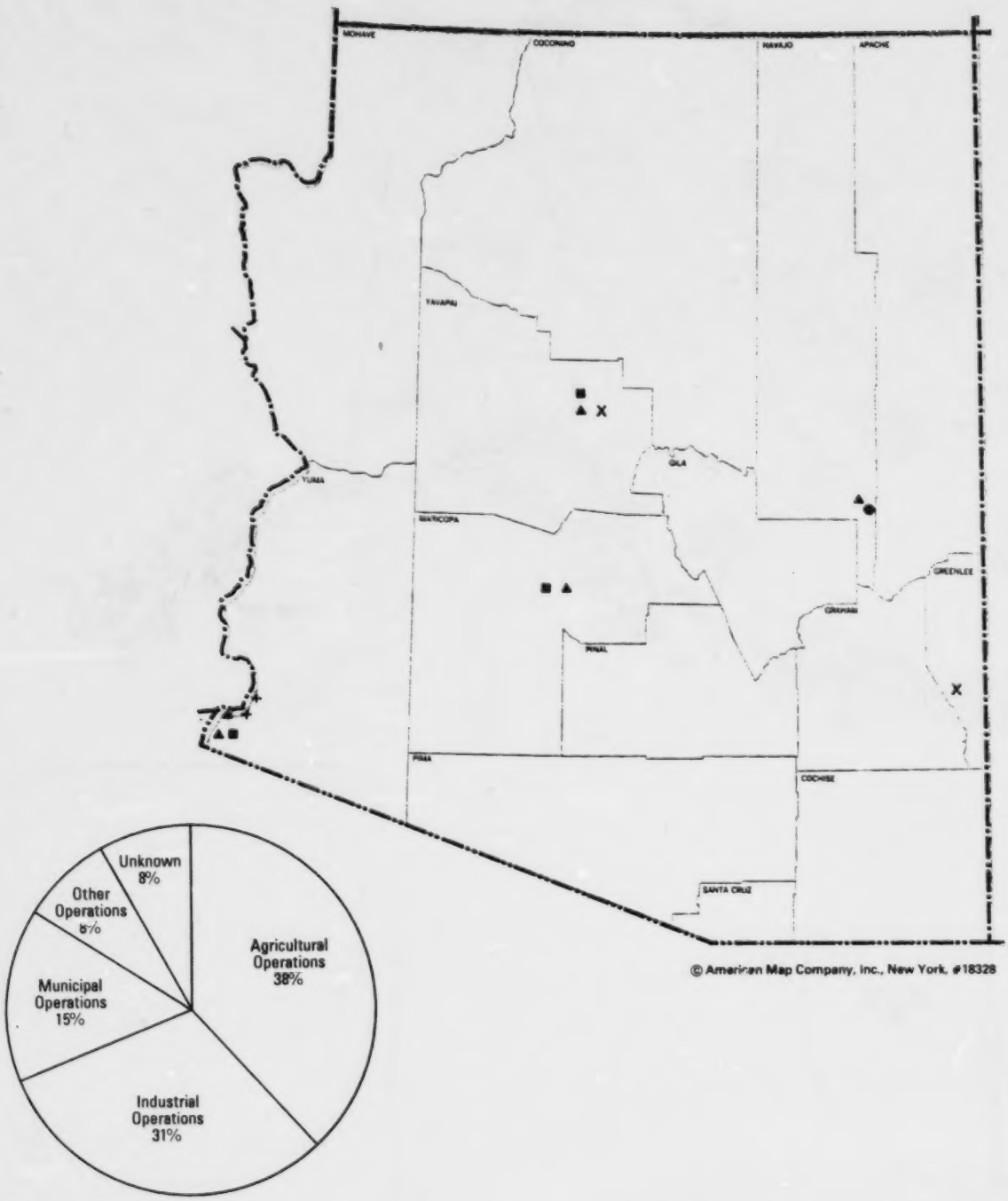
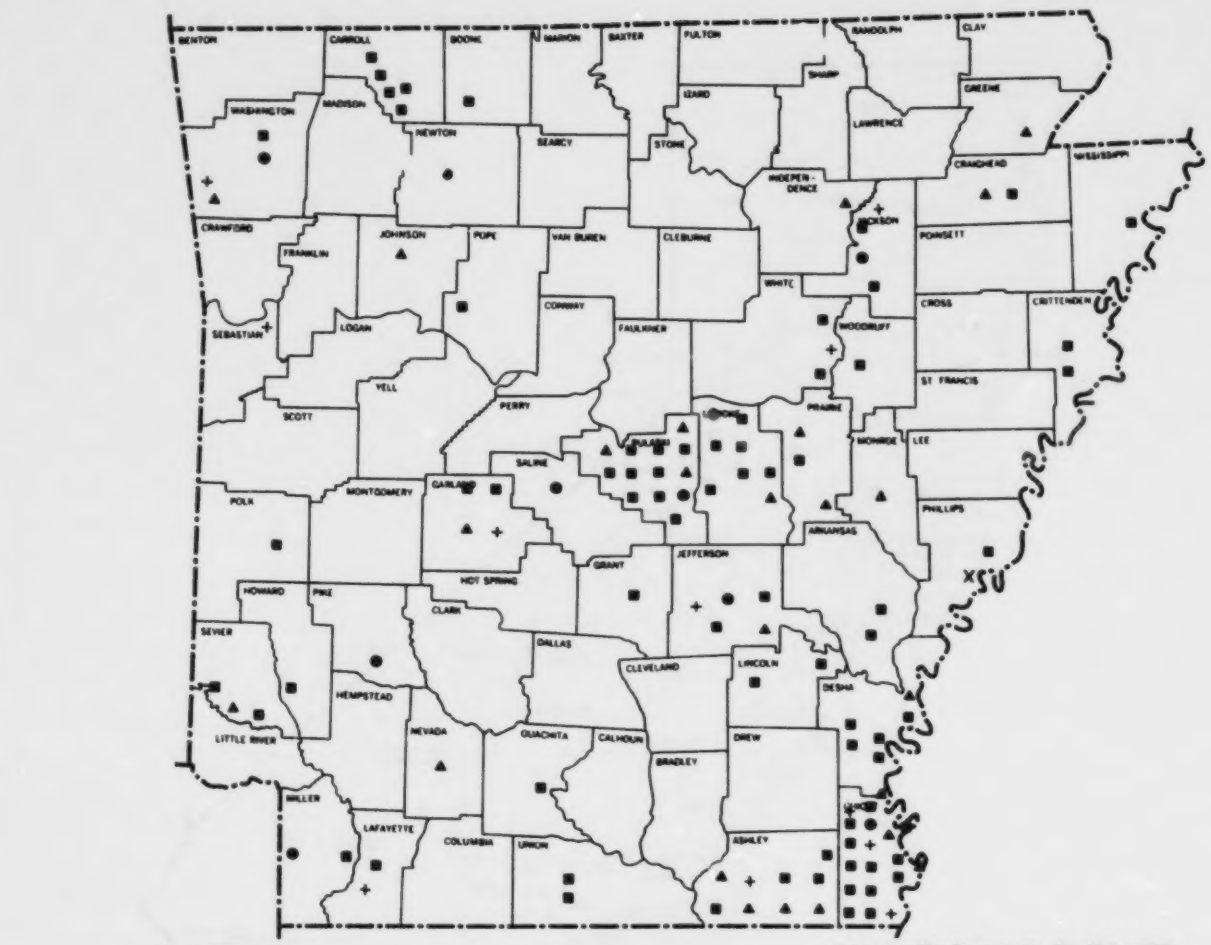


Figure 15
State of Arkansas—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



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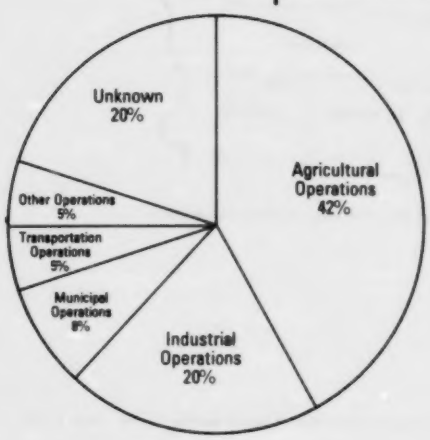


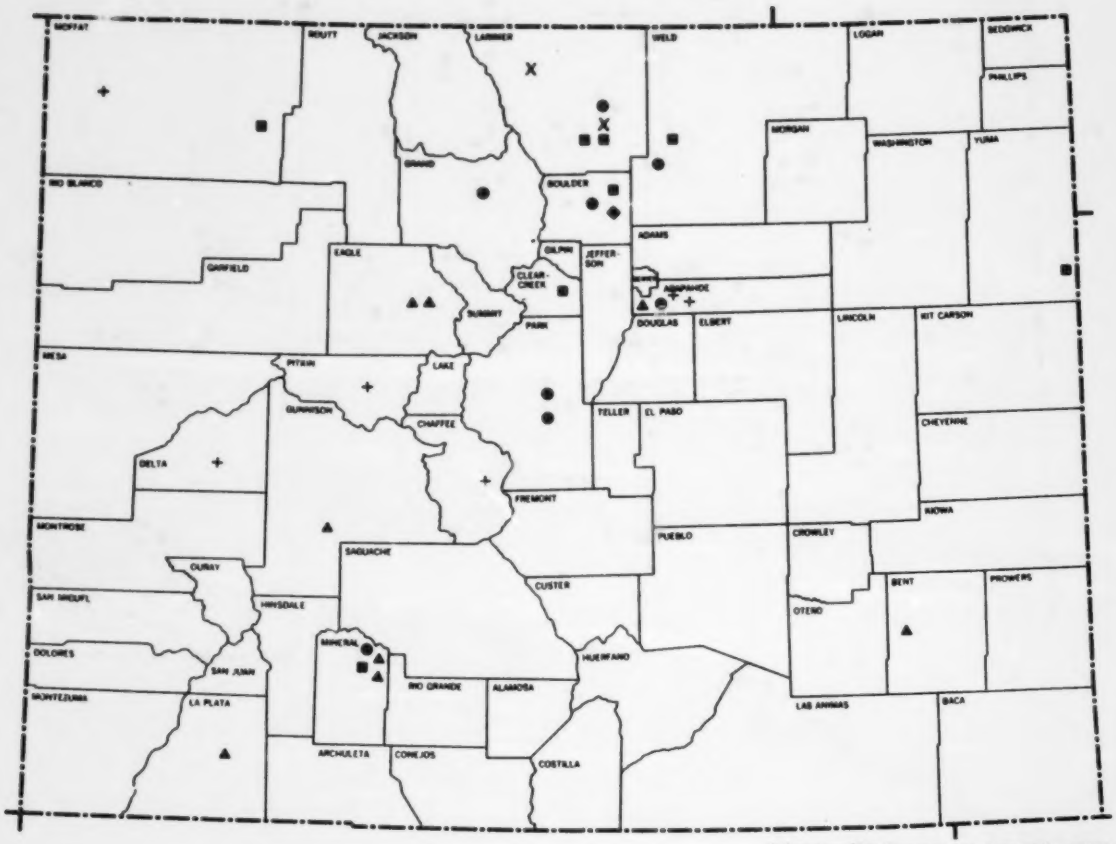
Figure 16
State of California—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

* Indicates the number of reports and the number of fish killed.

Figure 17
State of Colorado—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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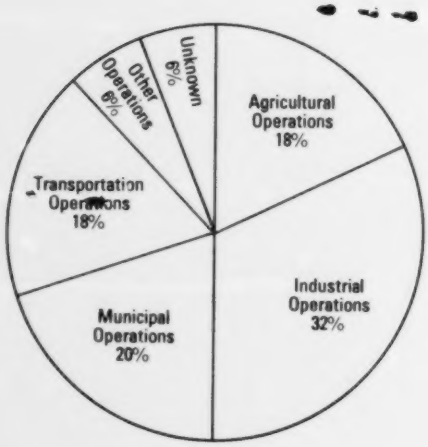
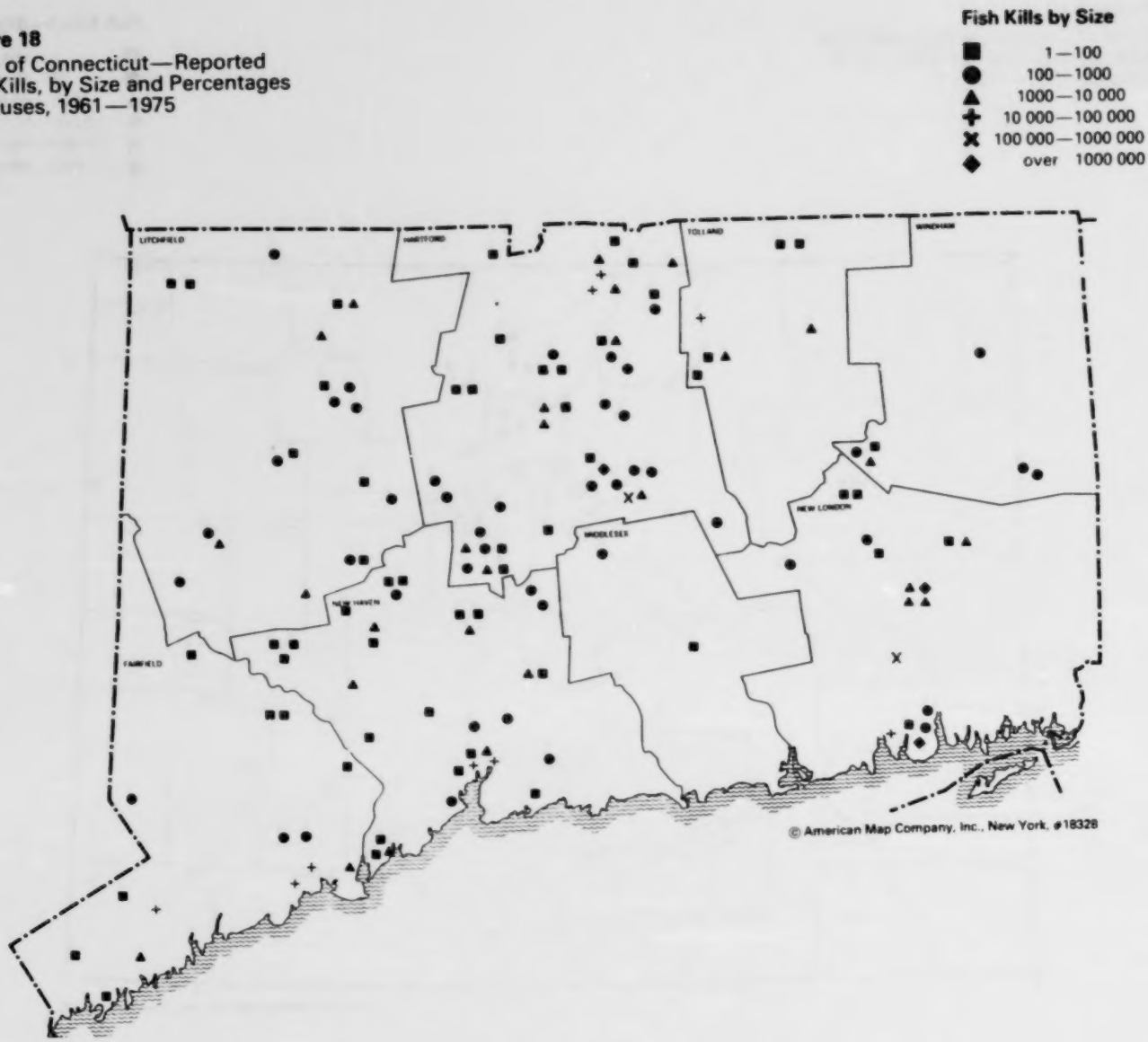


Figure 18
State of Connecticut—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



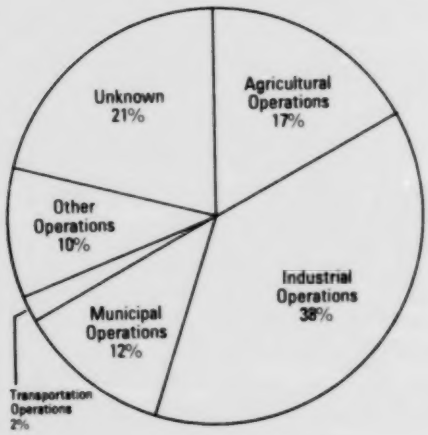
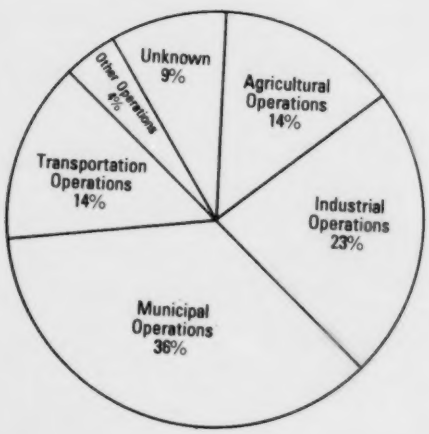


Figure 19
State of Delaware—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



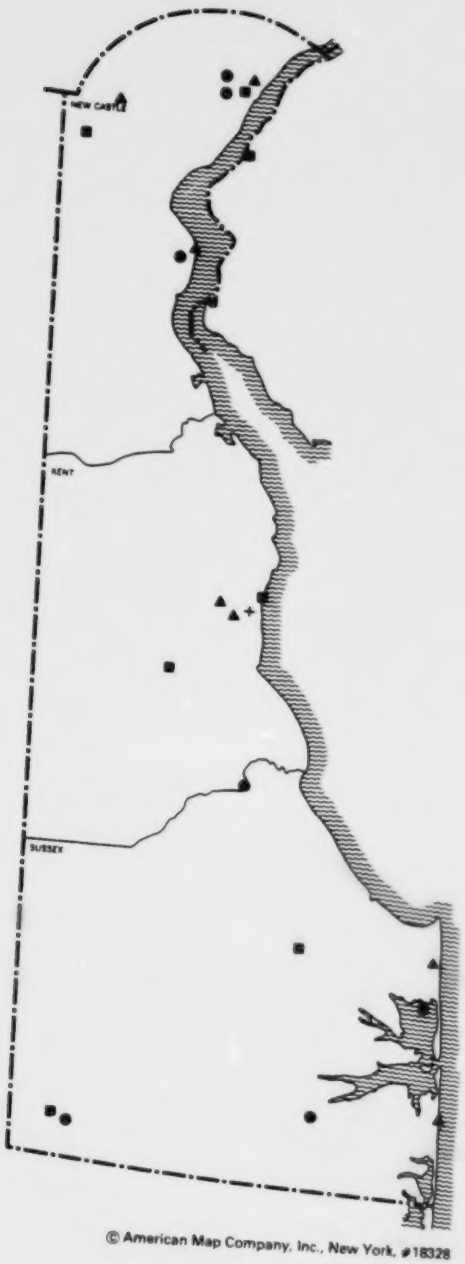
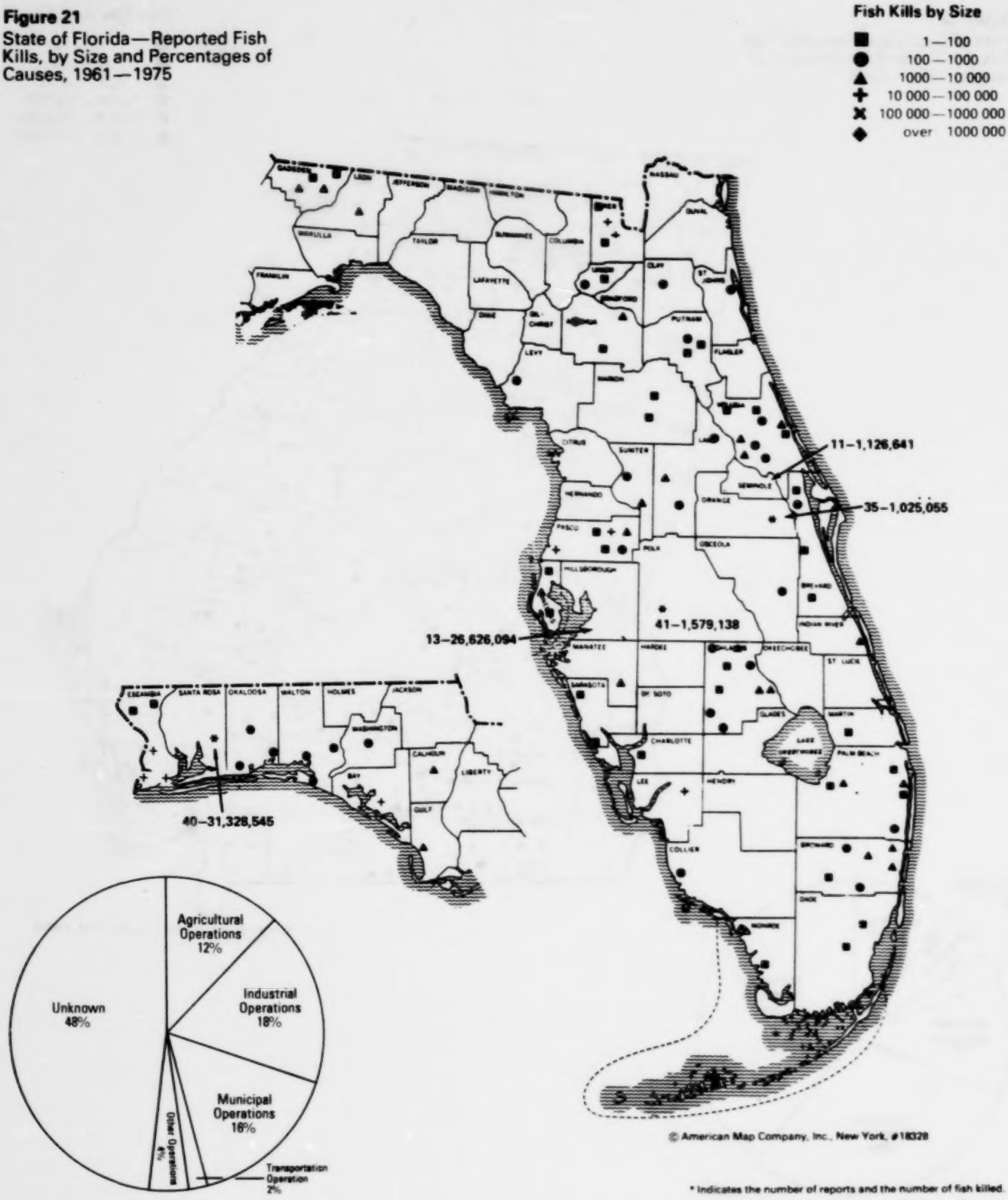


Figure 20
District of Columbia—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000

Figure 21
State of Florida—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



* Indicates the number of reports and the number of fish killed.

Figure 22
State of Georgia—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

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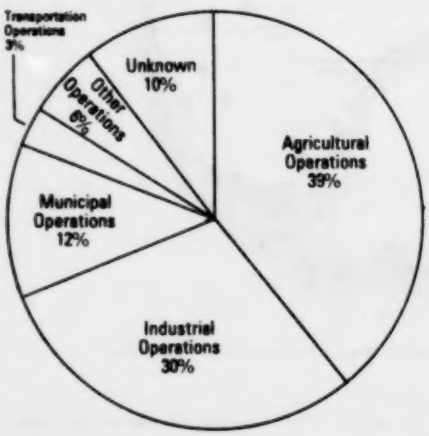
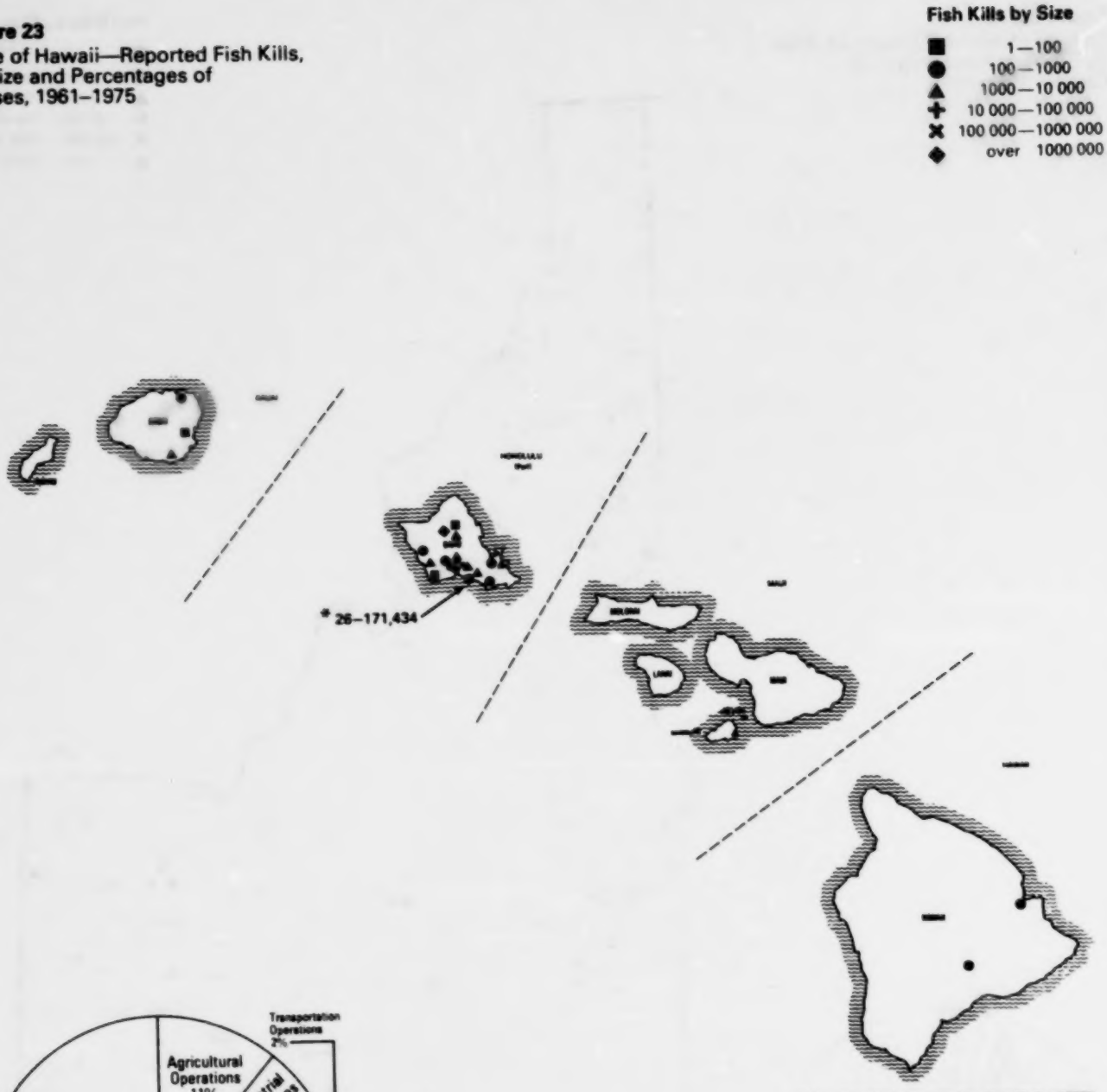


Figure 23
State of Hawaii—Reported Fish Kills, by Size and Percentages of Causes, 1961–1975



* Indicates the number of reports and the number of fish killed.

Figure 24
State of Idaho—Reported Fish Kills, by Size and Percentages of Causes, 1961–1975

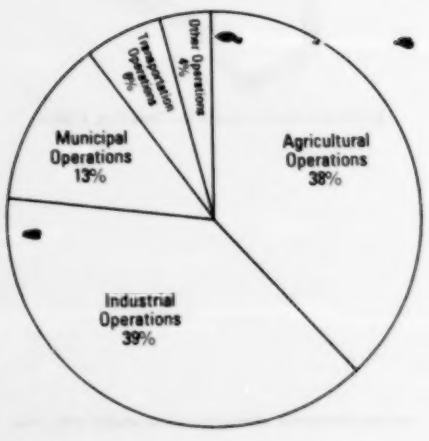


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Figure 25
State of Illinois—Reported Fish Kills, by Size and Percentages of Causes, 1961–1975

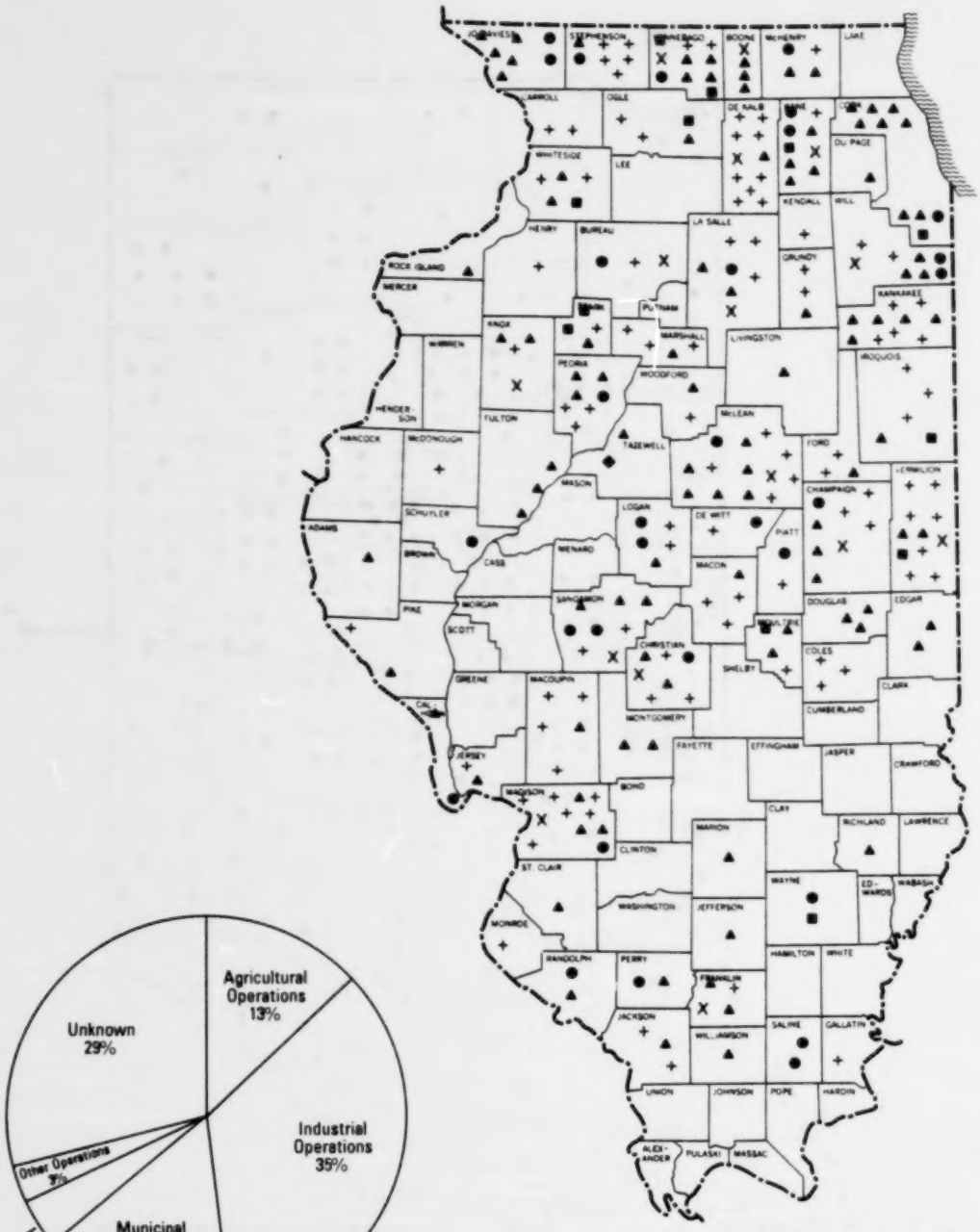
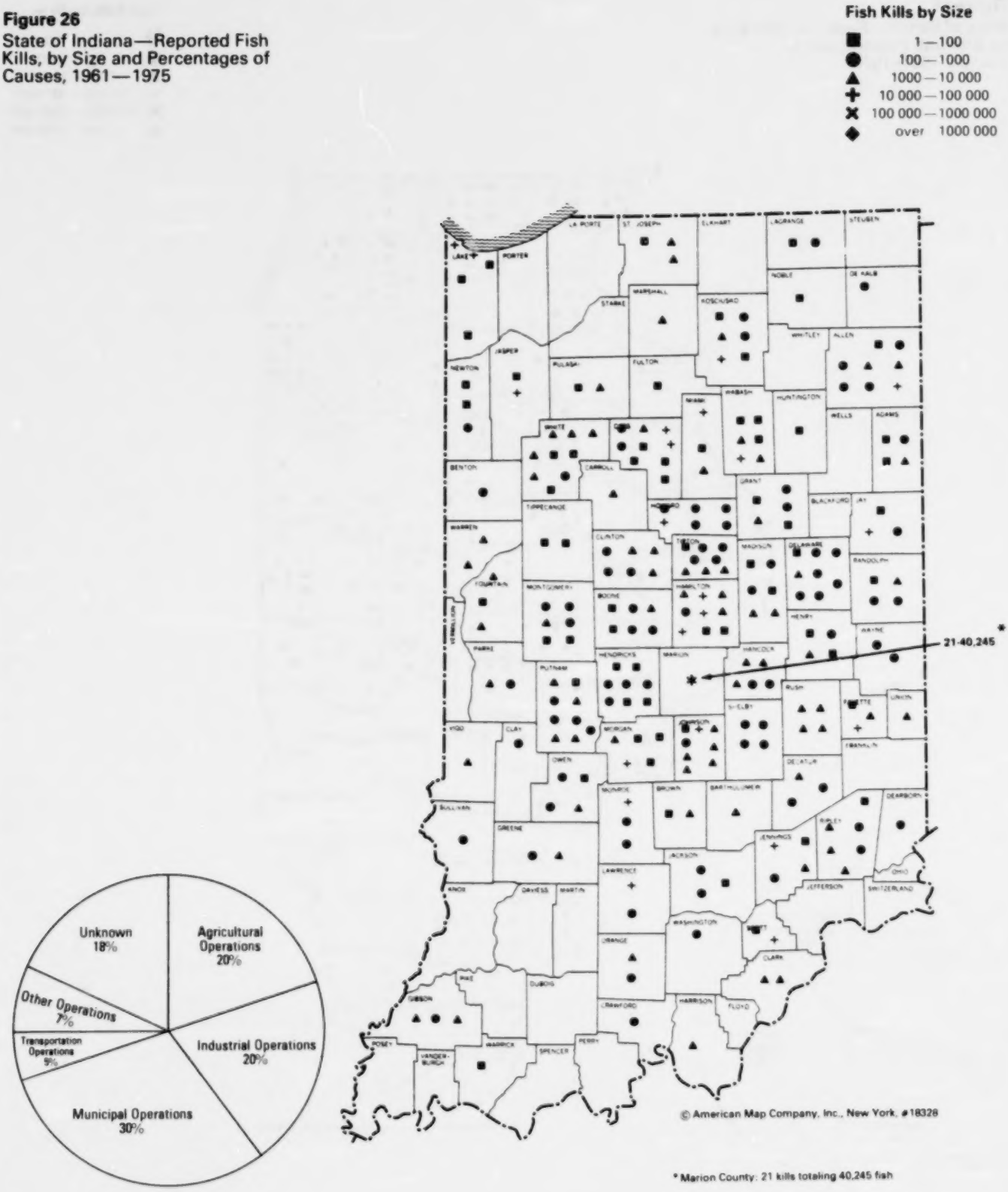
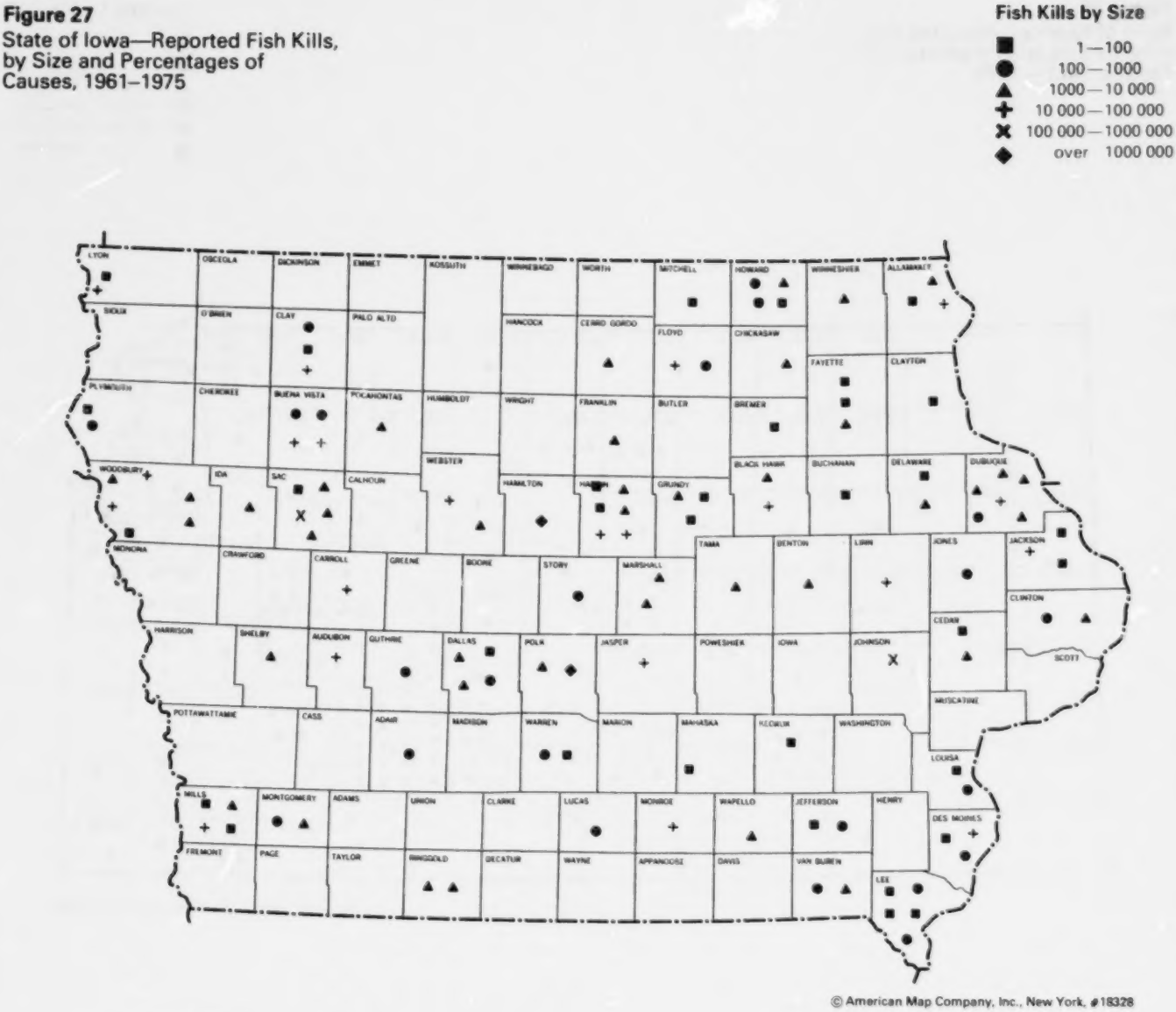


Figure 26
State of Indiana—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



* Marion County: 21 kills totaling 40,245 fish

Figure 27
State of Iowa—Reported Fish Kills, by Size and Percentages of Causes, 1961–1975



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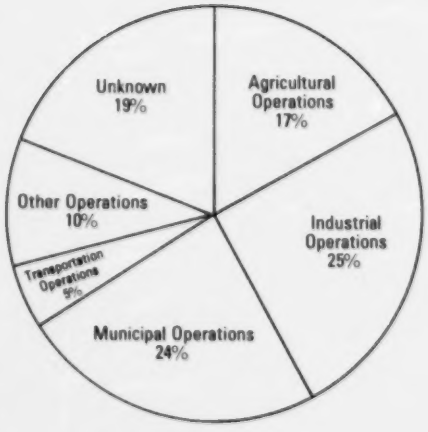
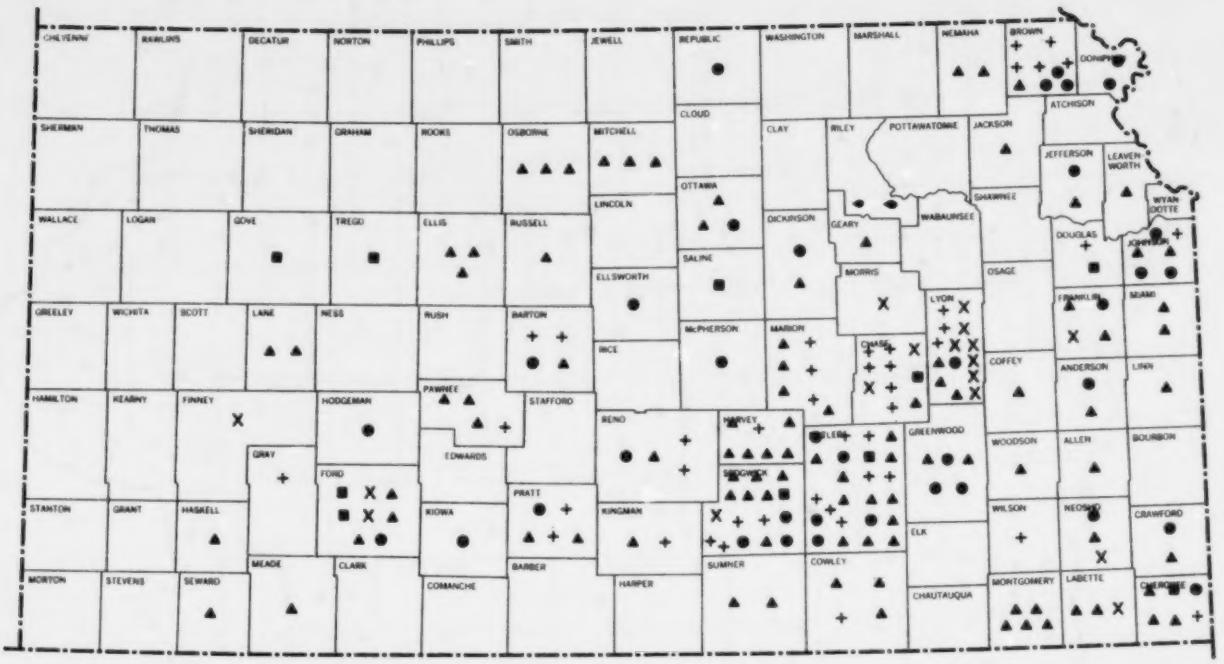


Figure 28
State of Kansas—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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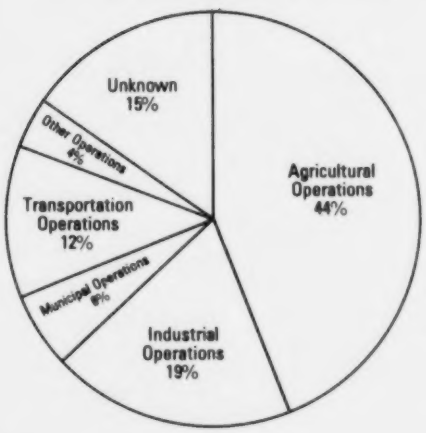
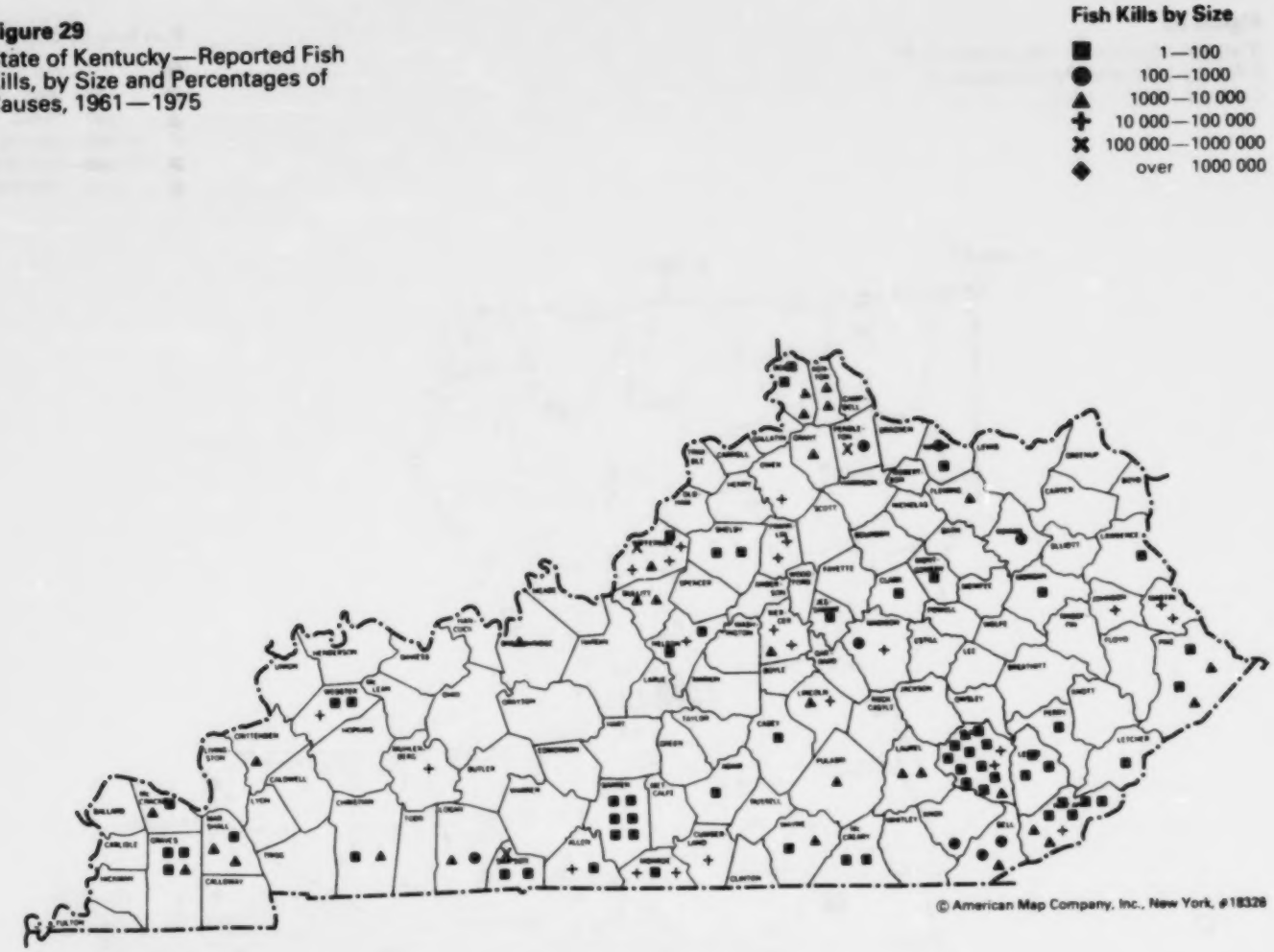


Figure 29
State of Kentucky—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



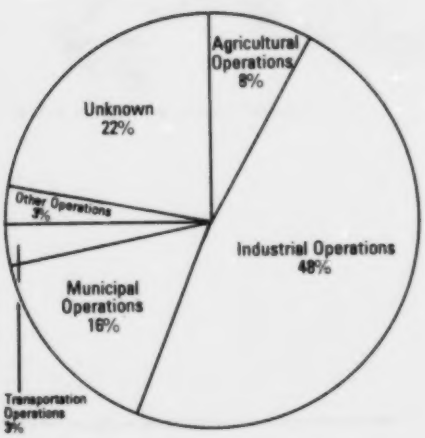
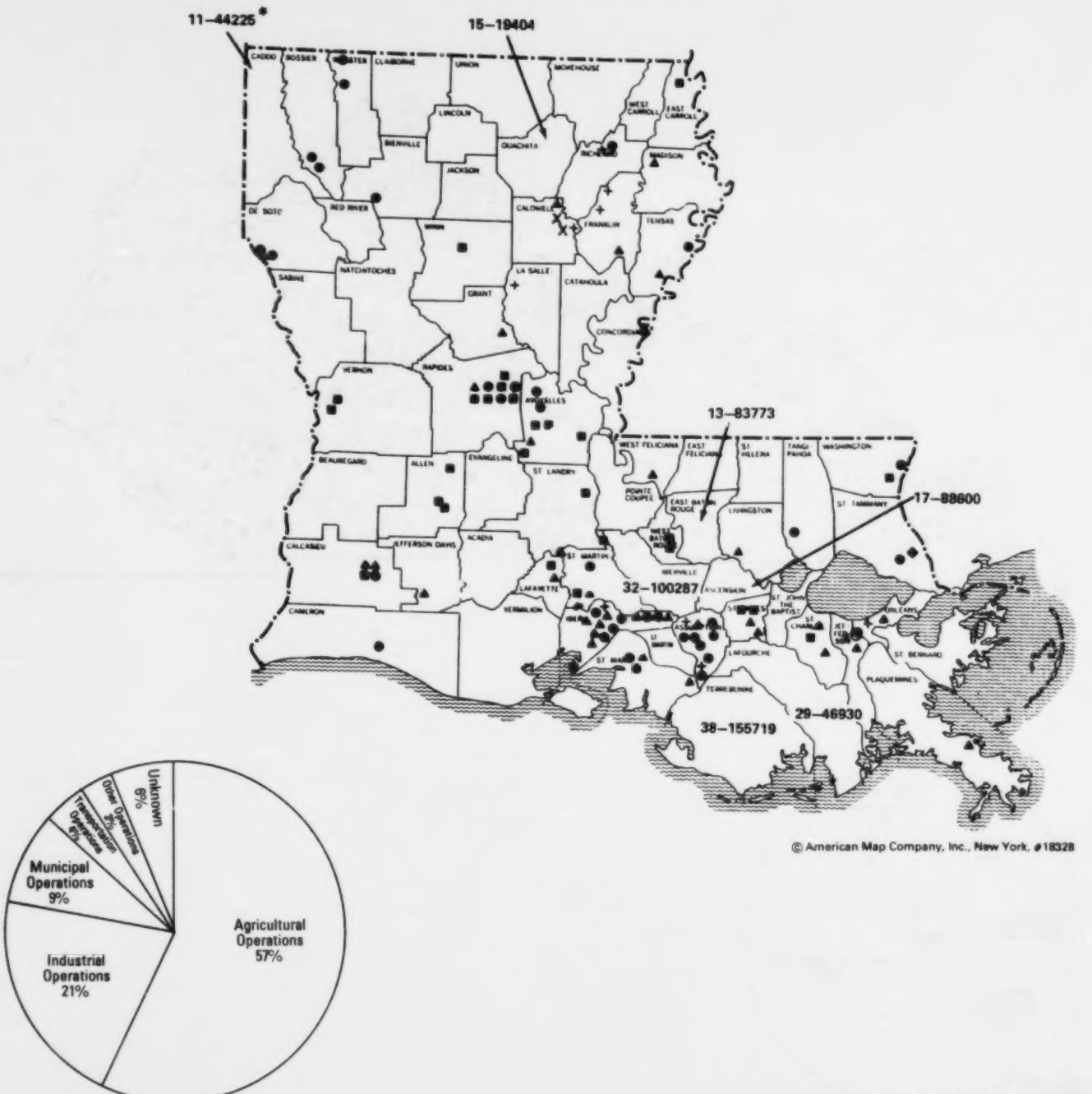
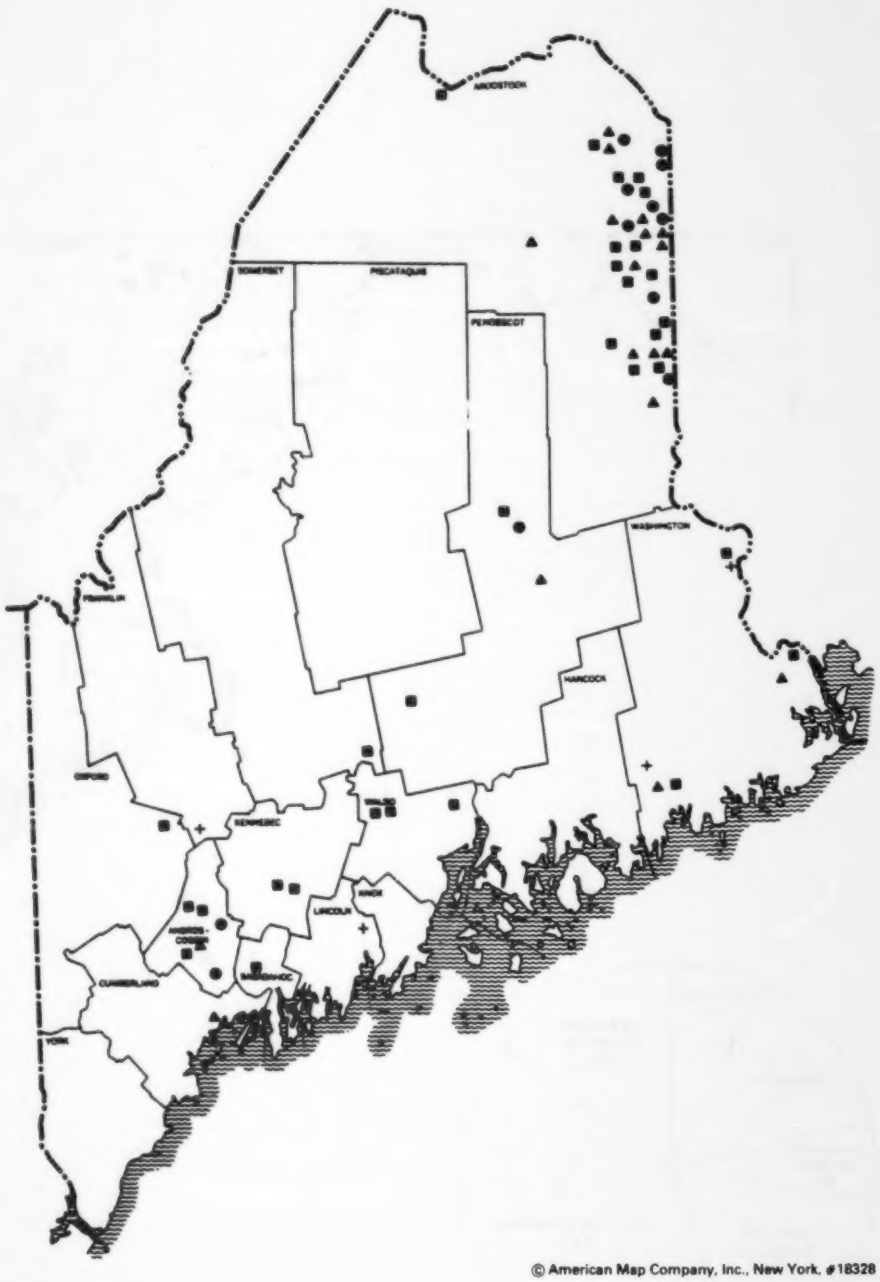


Figure 30
State of Louisiana—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



* Indicates the number of reports and the number of fish killed.

Figure 31
State of Maine—Reported Fish Kills by Size and Percentages of Causes, 1961–1975



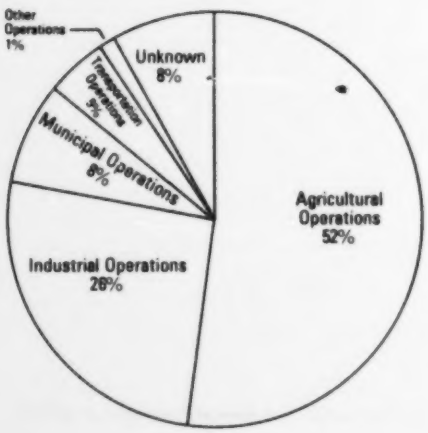


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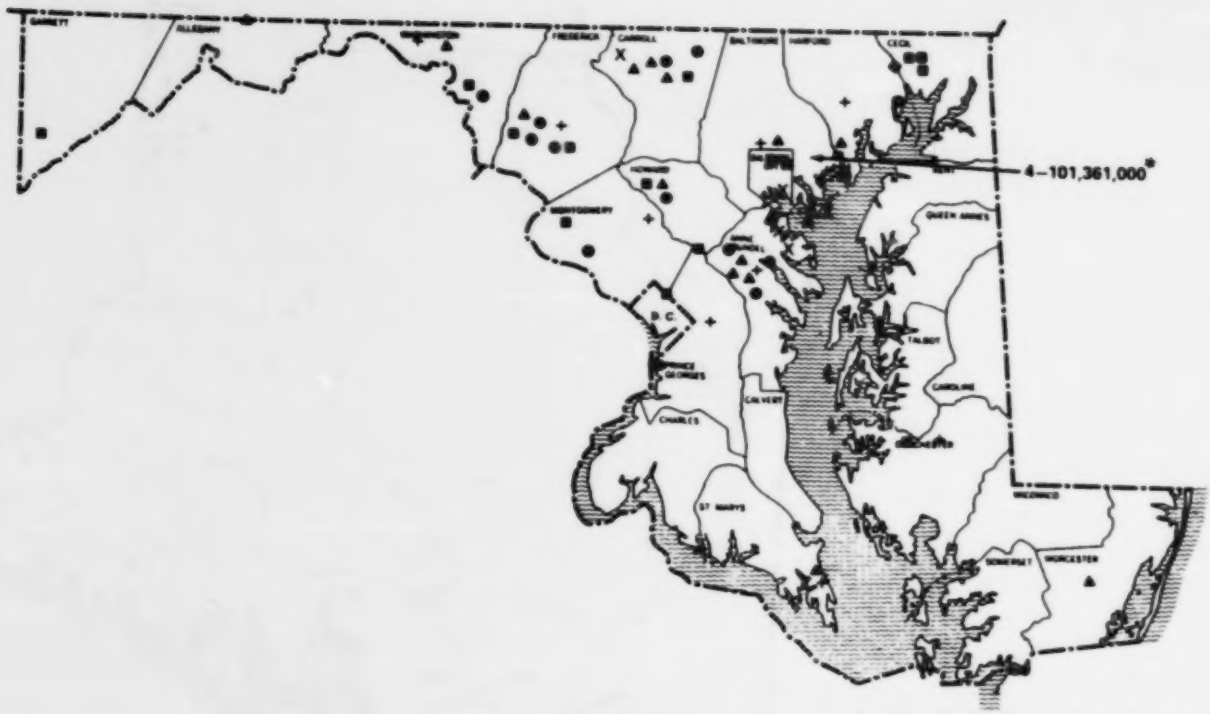
Figure 32
State of Maryland—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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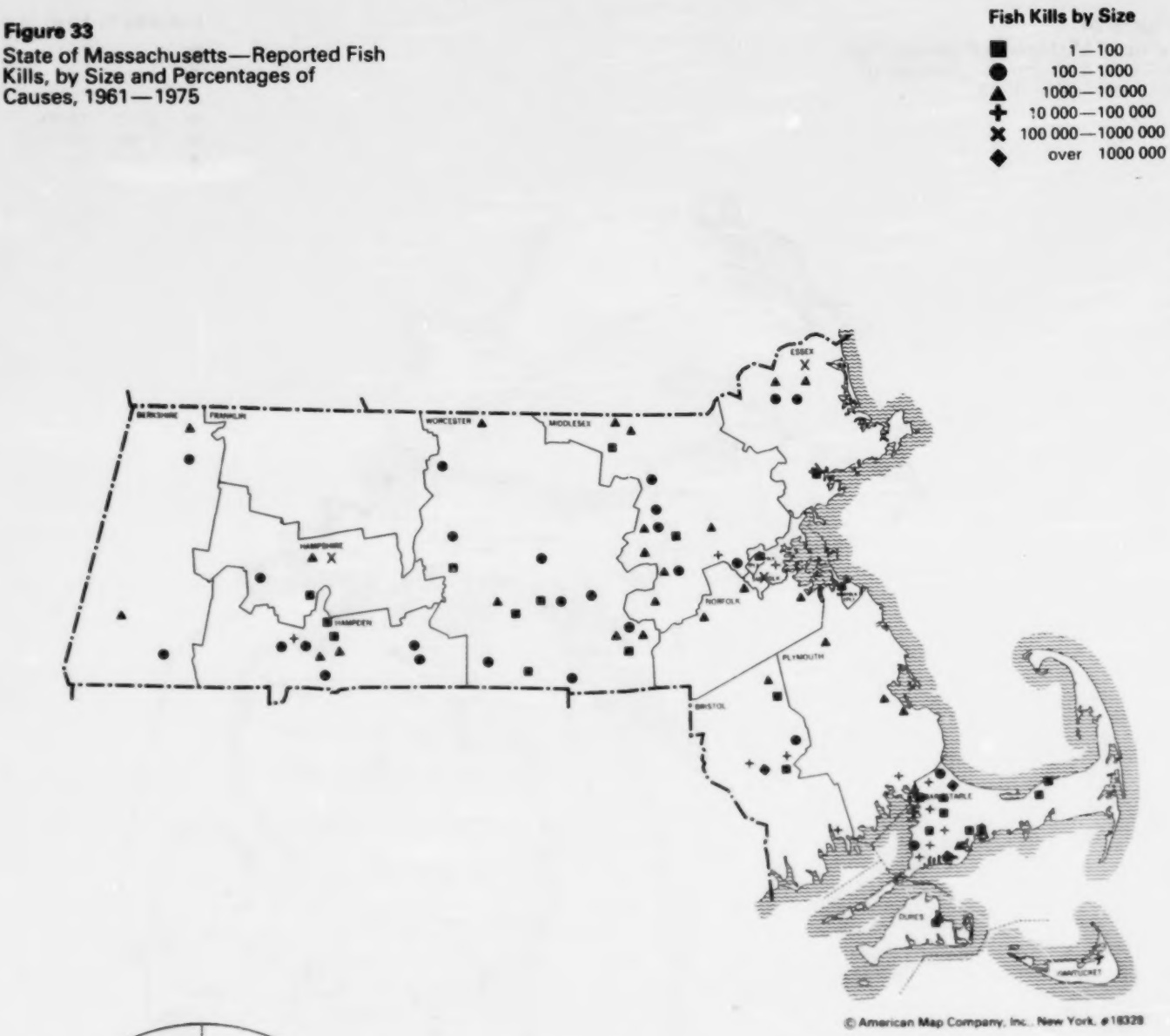
* Indicates the number of reports and the number of fish killed.

Figure 33
State of Massachusetts—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



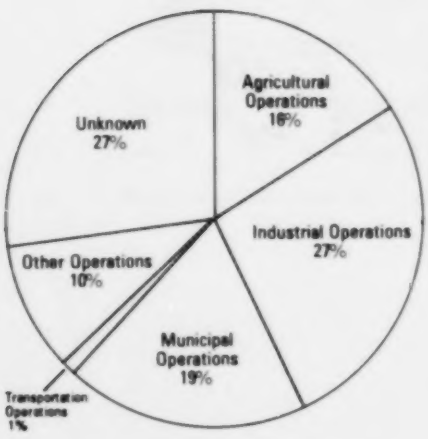


Figure 34
State of Michigan—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

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Figure 35
State of Minnesota—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

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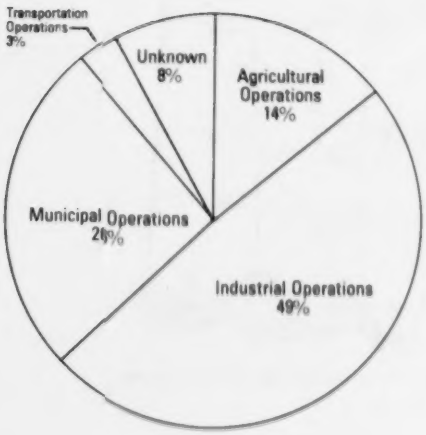

Figure 36
State of Mississippi—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

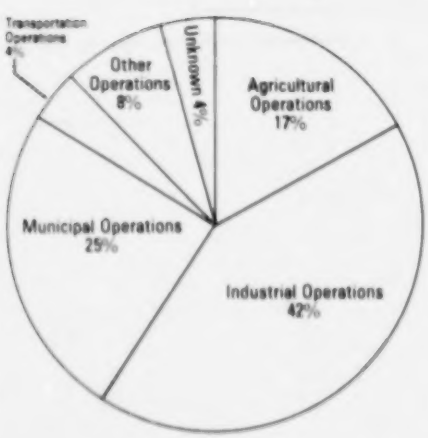

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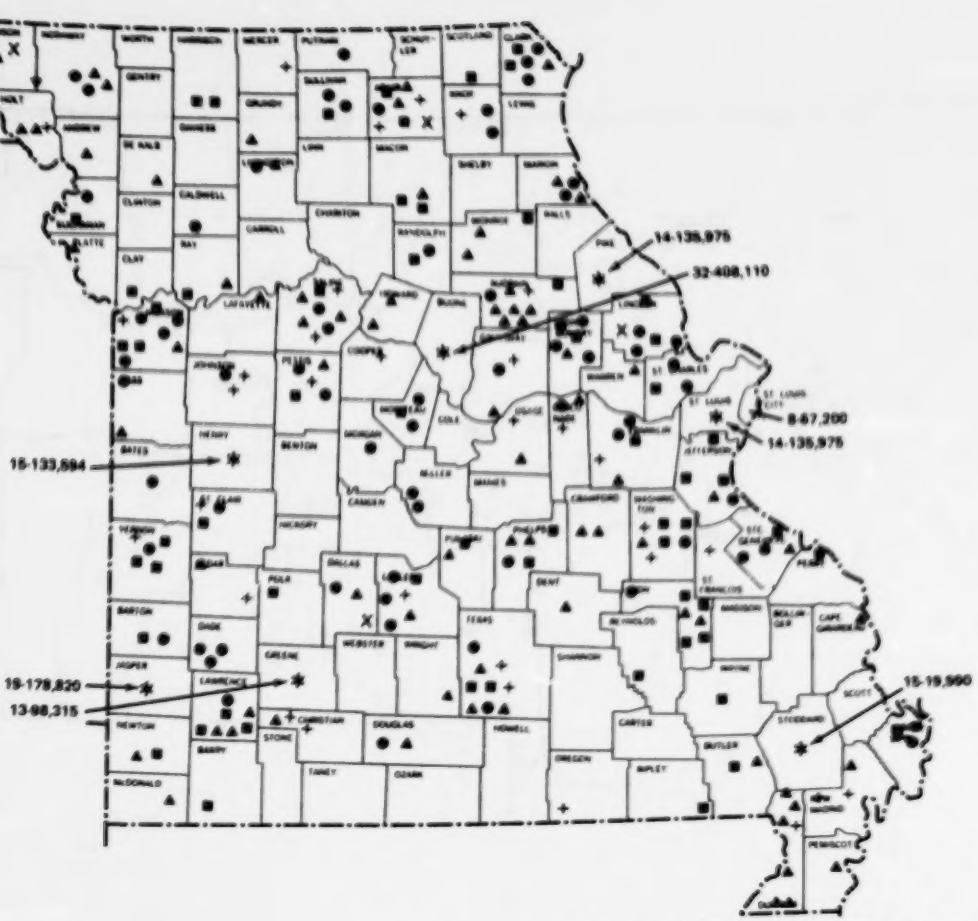
Figure 37
State of Missouri—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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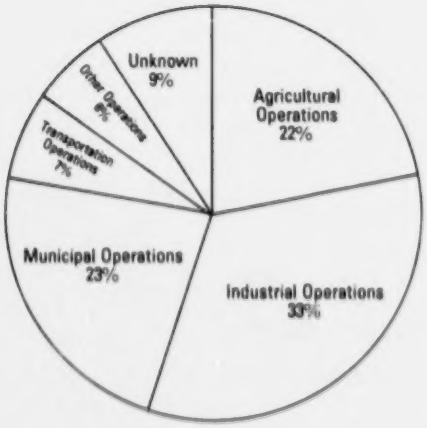
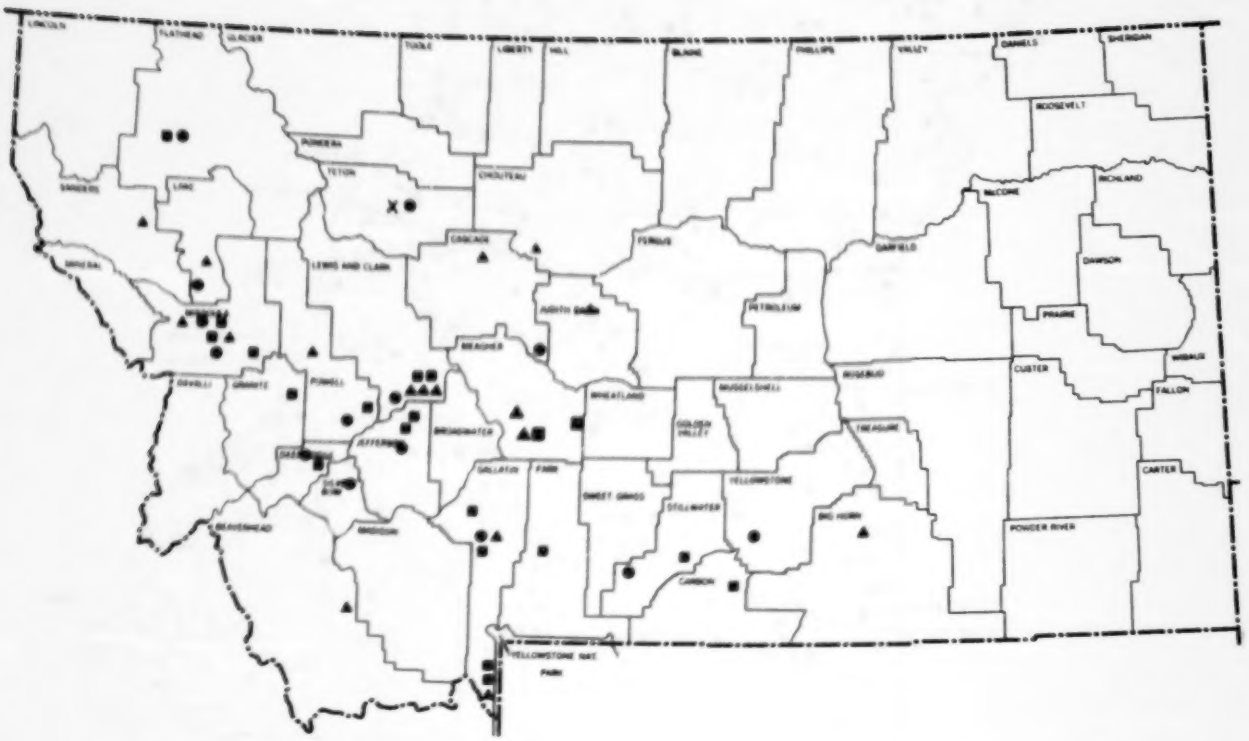


* Indicates the number of reports and the number of fish killed.

Figure 38
State of Montana—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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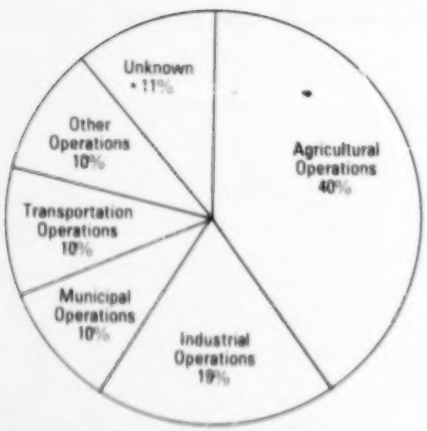
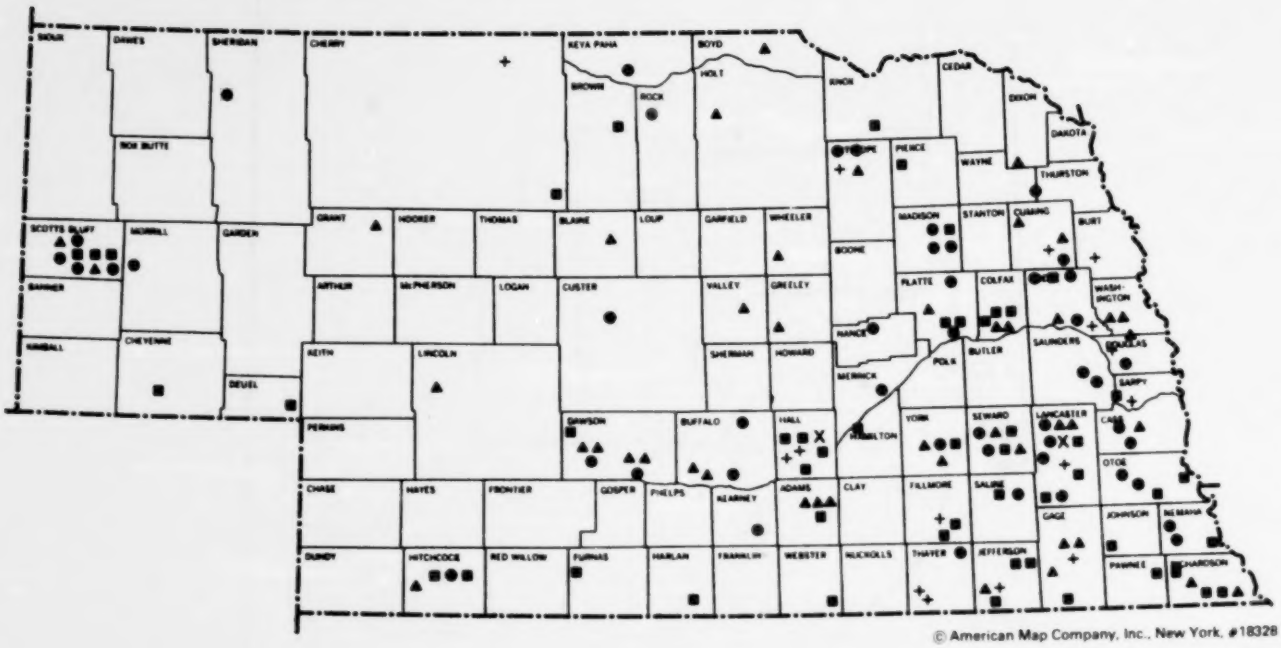


Figure 39
State of Nebraska—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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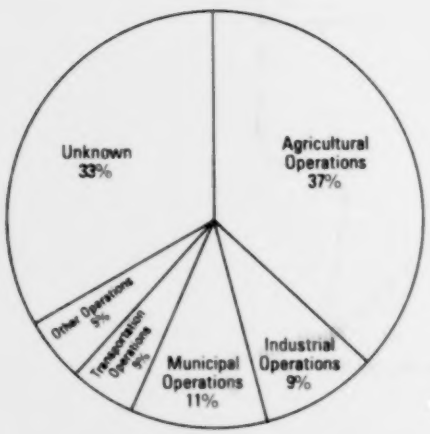

Figure 40
State of Nevada—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

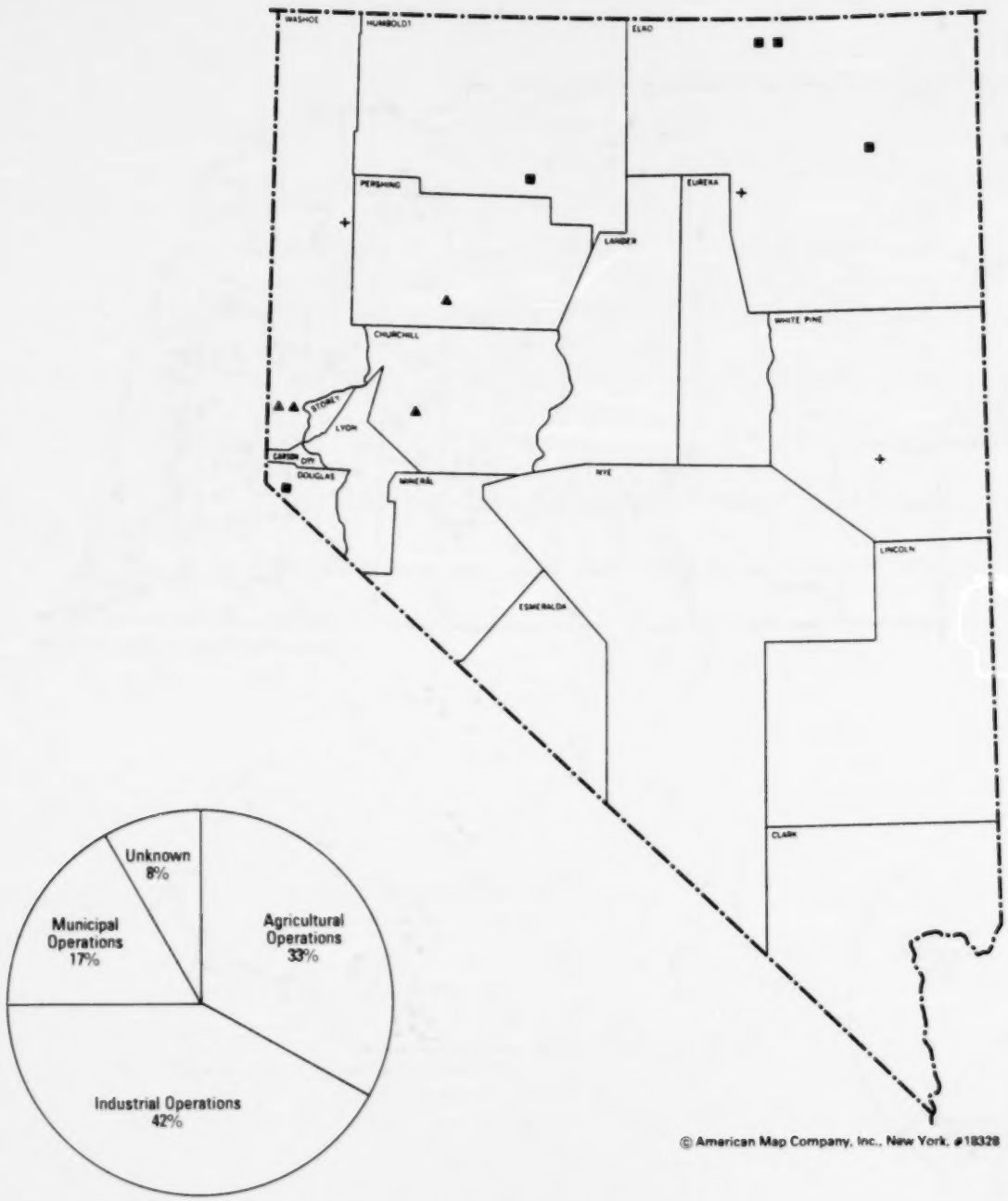

Figure 41
State of New Hampshire—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

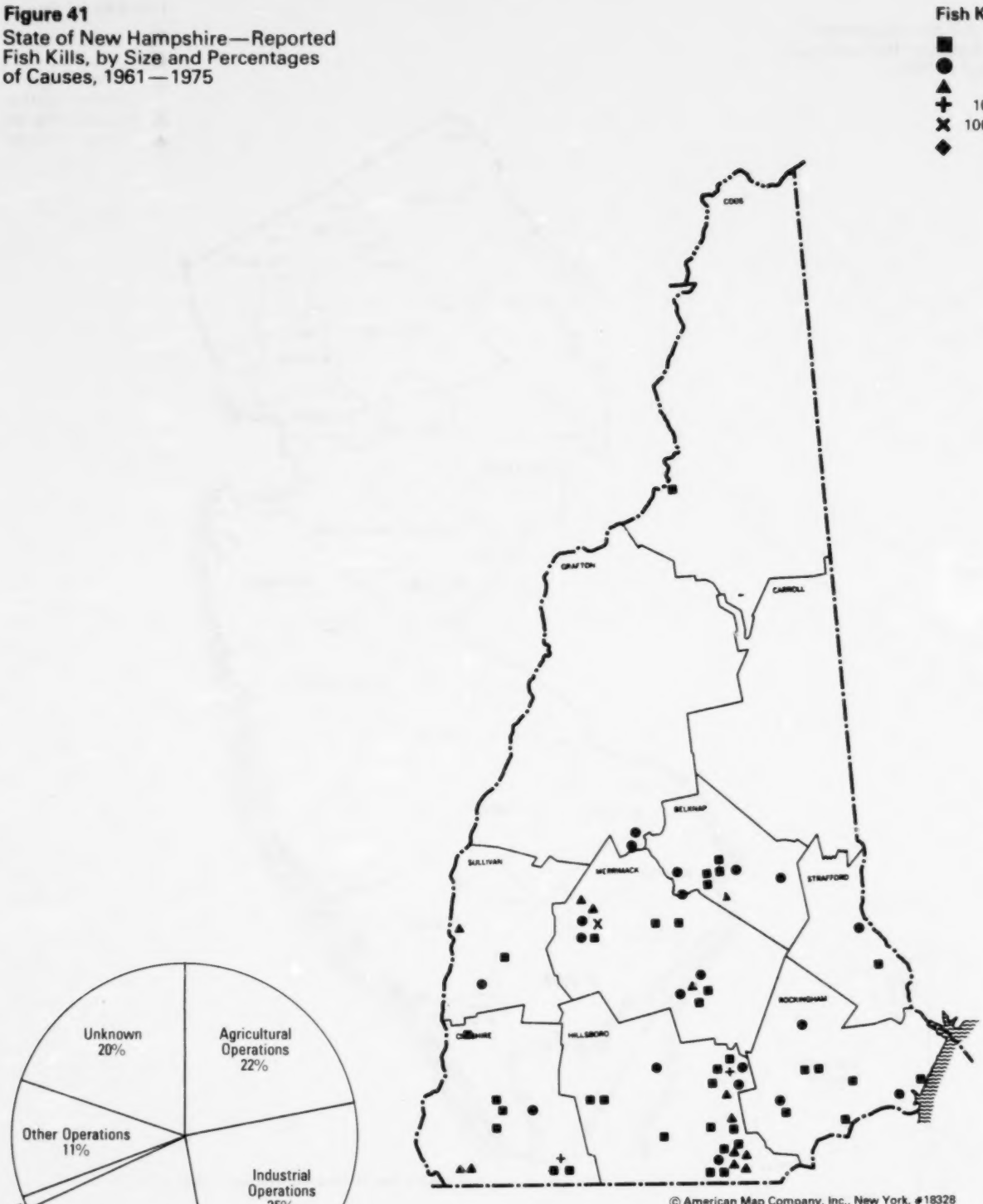

Figure 42
State of New Jersey—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

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* Indicates the number of reports, number of fish killed, and county where kill occurred.

Figure 43
State of New Mexico—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

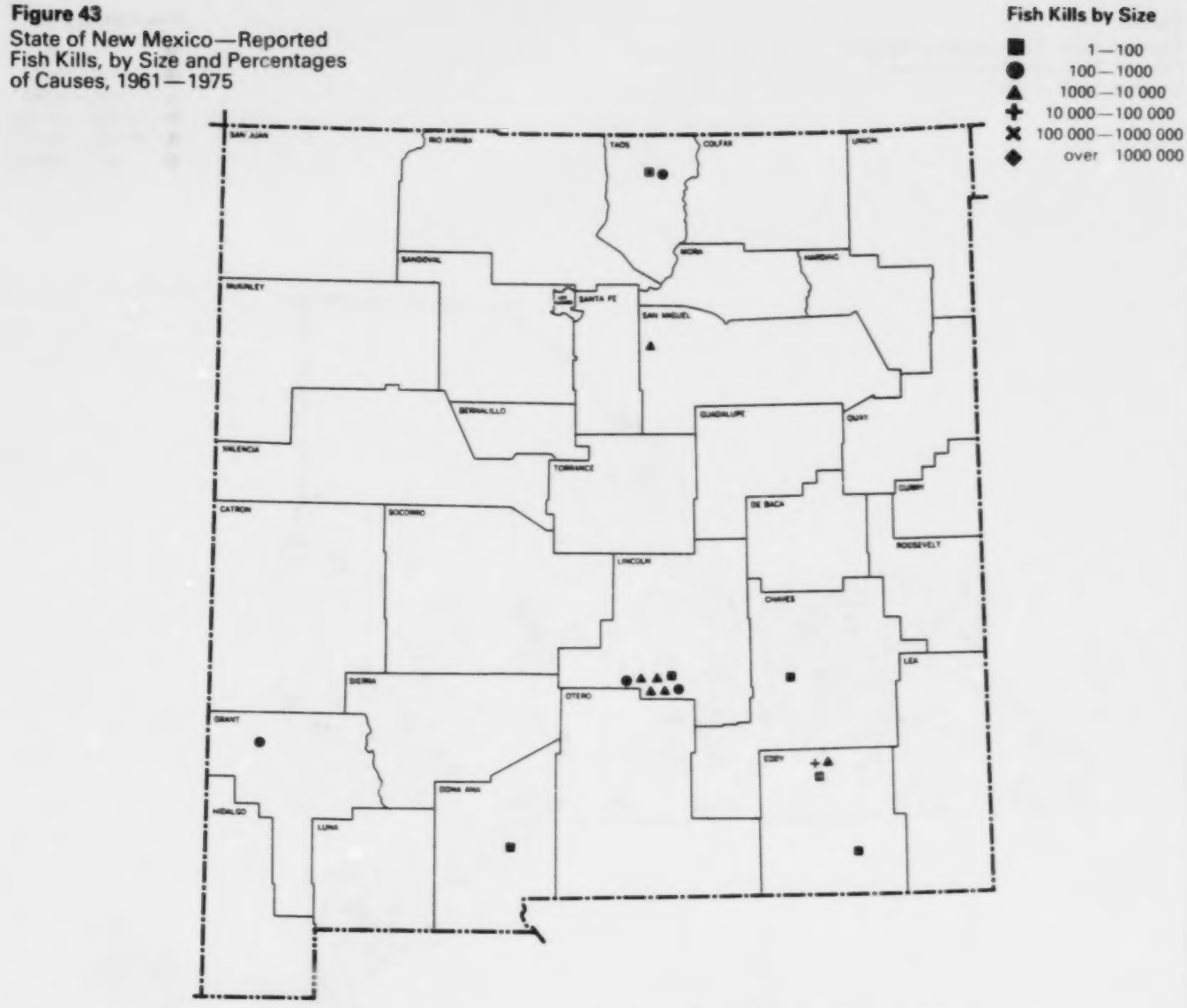

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Figure 44
State of New York—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000

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Figure 45
State of North Carolina—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000

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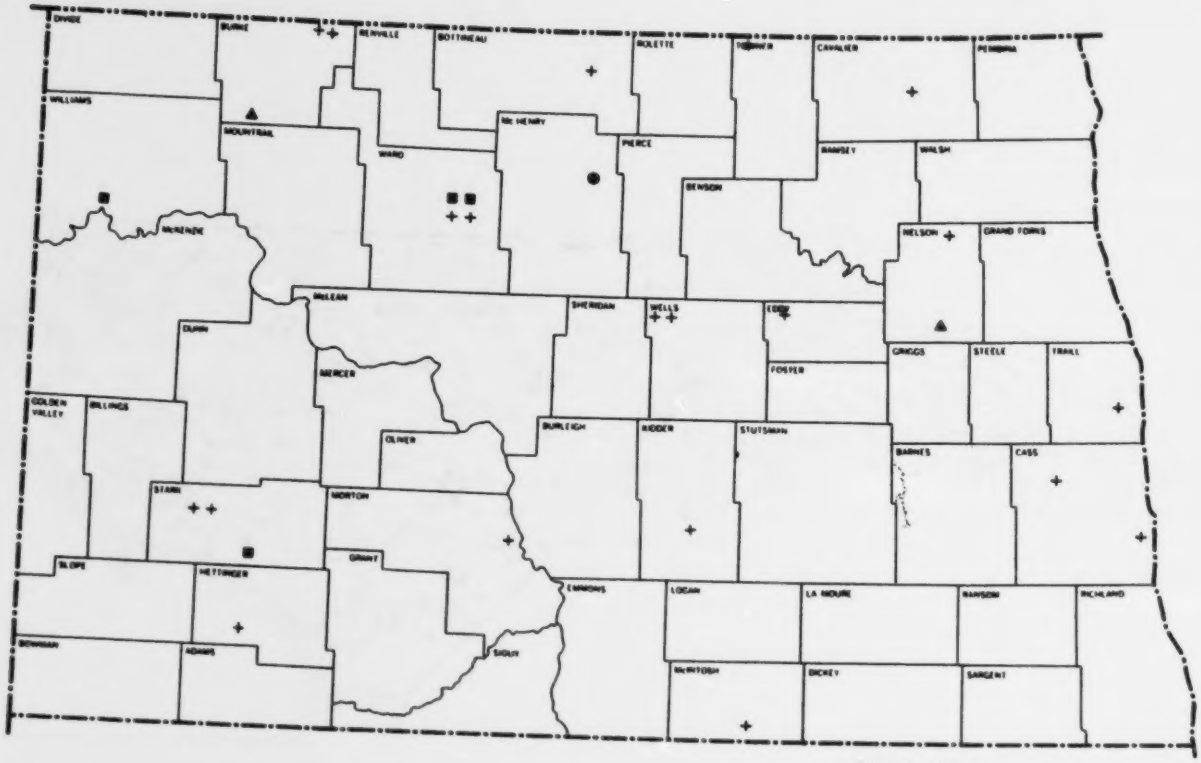
Figure 46
State of North Dakota—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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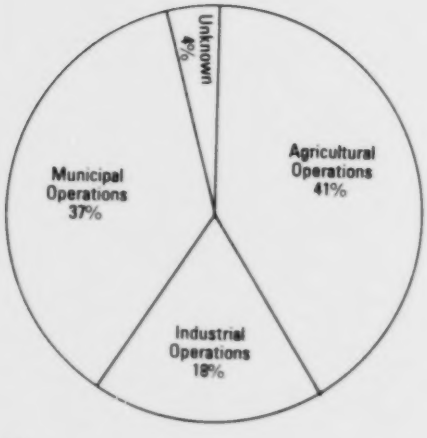

Figure 47
State of Ohio—Reported Fish Kills, by Size and Percentages of Causes, 1961–1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000

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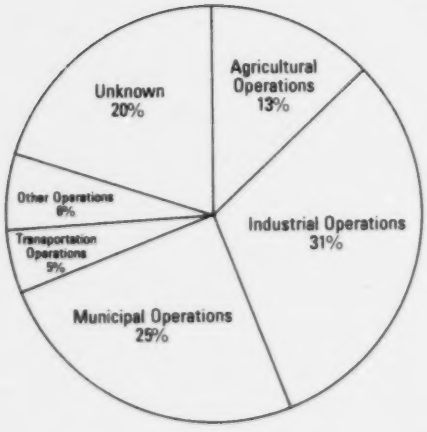
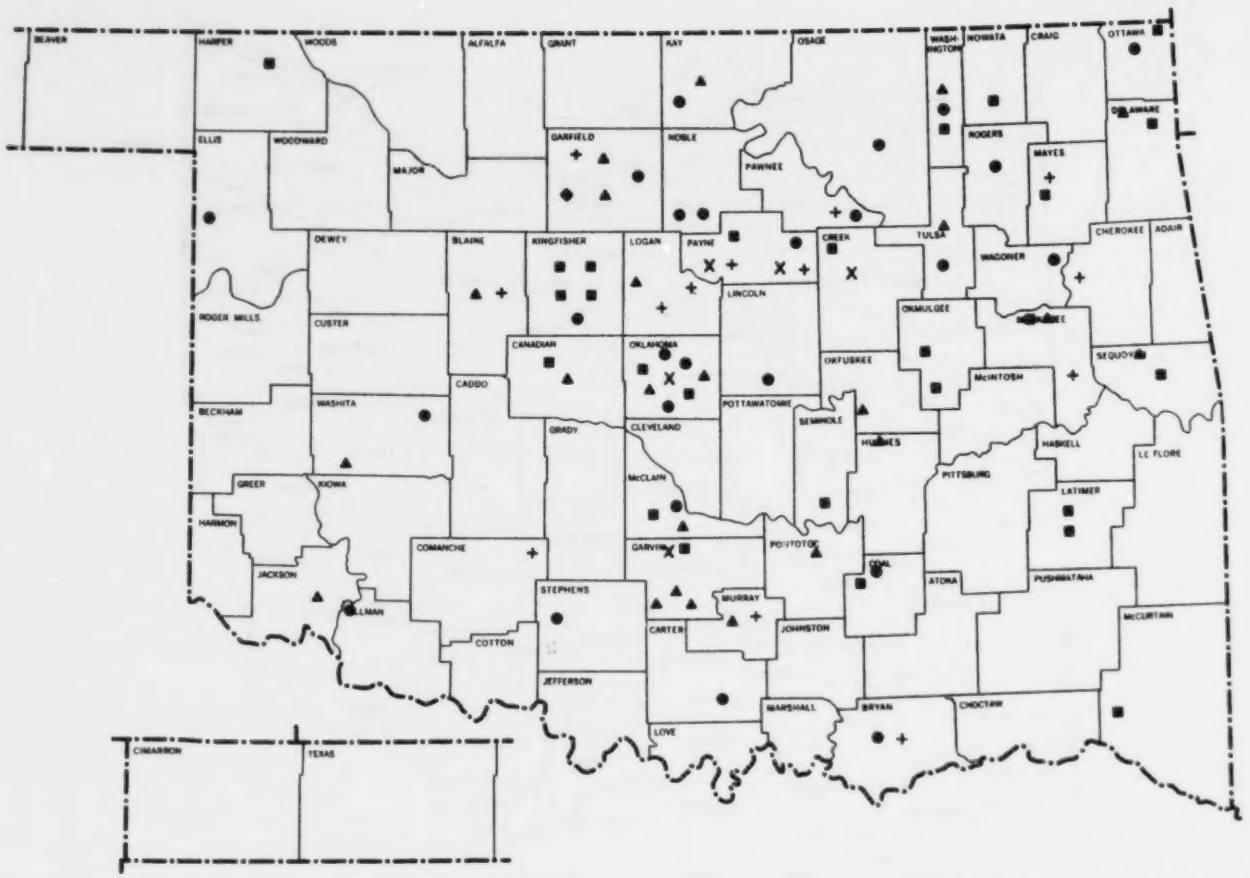


* Indicates the number of reports and the number of fish killed.

Figure 48
State of Oklahoma—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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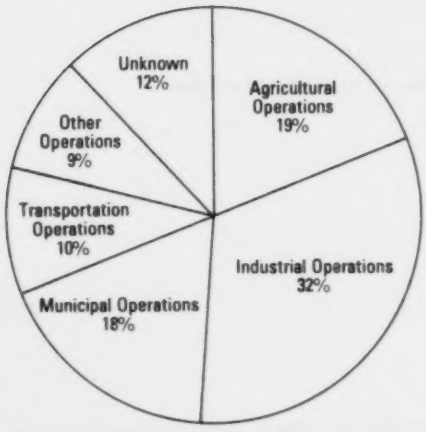


Figur 49
State of Oregon—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

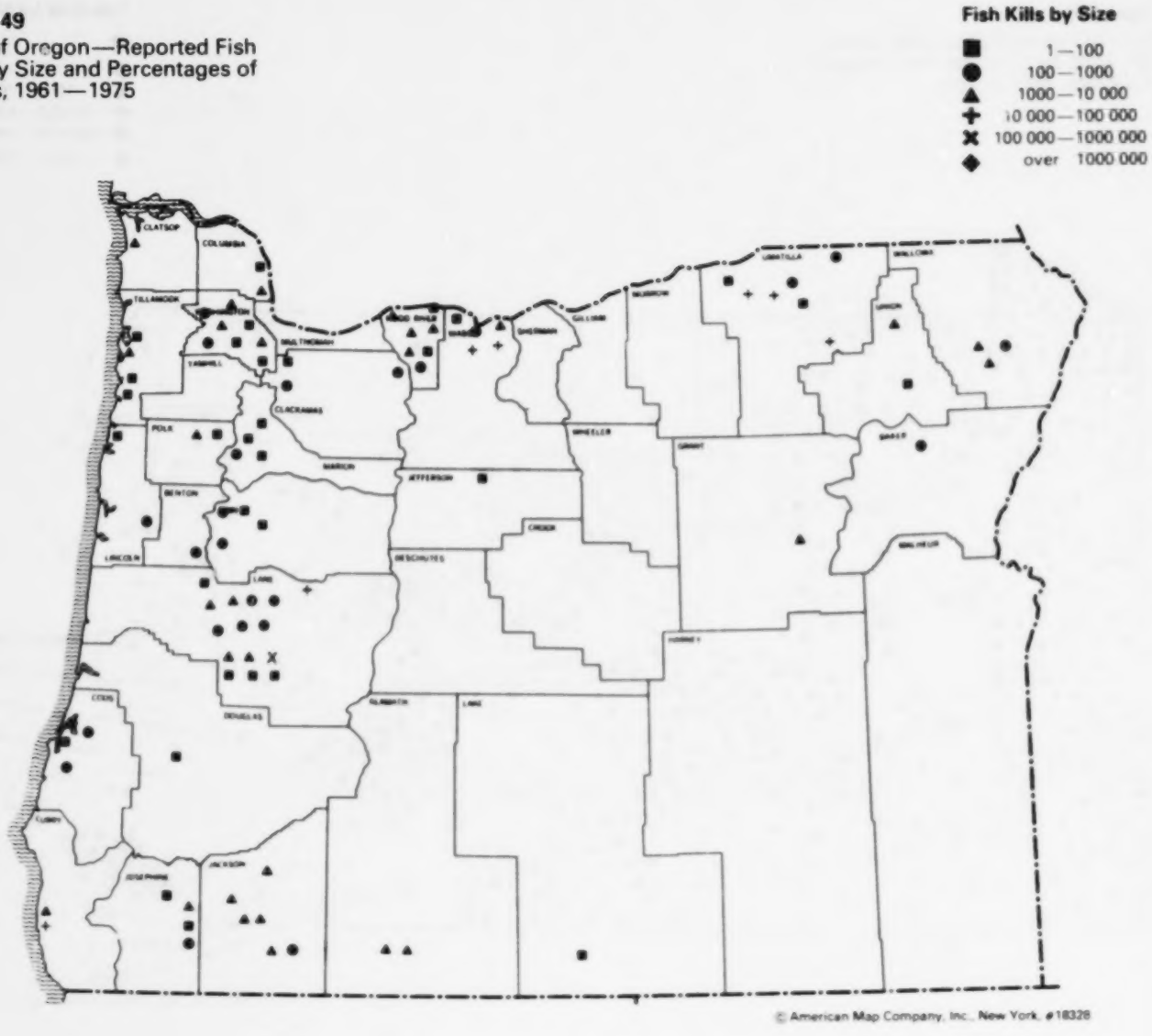
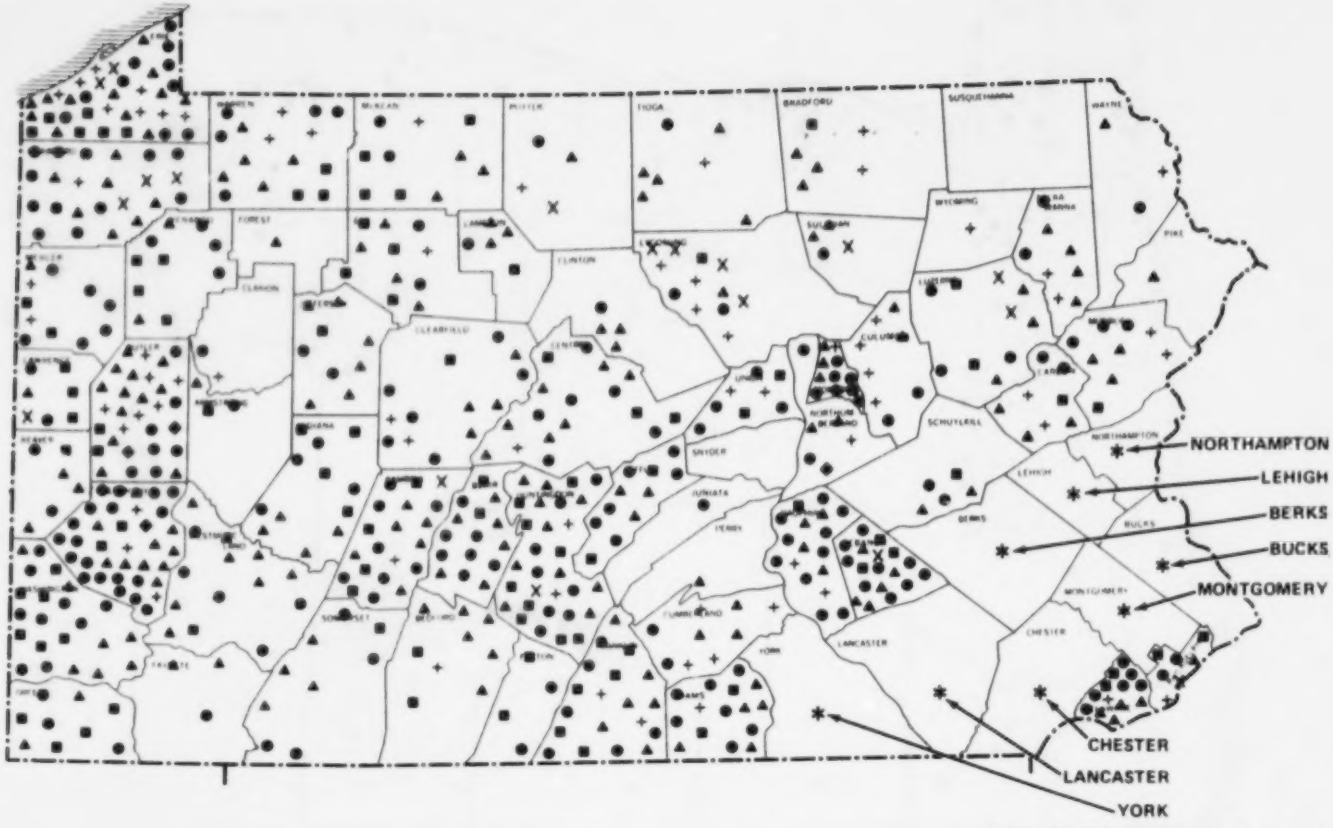


Figure 50
State of Pennsylvania—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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*BERKS COUNTY:	47 KILLS	TOTALING	129,000 FISH
*BUCKS COUNTY:	33 KILLS	TOTALING	196,000 FISH
*CHESTER COUNTY:	38 KILLS	TOTALING	83,200 FISH
*LANCASTER COUNTY:	41 KILLS	TOTALING	197,700 FISH
*LEHIGH COUNTY:	20 KILLS	TOTALING	82,100 FISH
*MONTGOMERY COUNTY:	24 KILLS	TOTALING	58,200 FISH
*NORTHAMPTON COUNTY:	54 KILLS	TOTALING	178,300 FISH
*YORK COUNTY:	45 KILLS	TOTALING	190,000 FISH

*Indicates the number of reports, number of fish killed, and county where kill occurred.

Figure 51
State of Rhode Island—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

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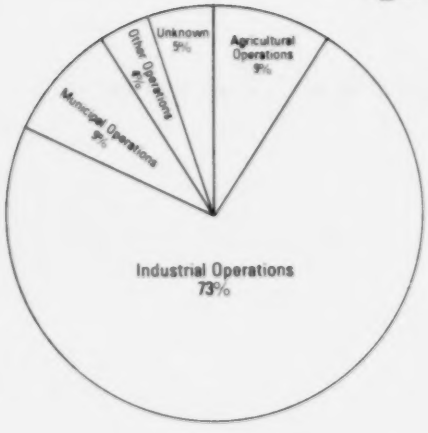

Figure 52
State of South Carolina—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000

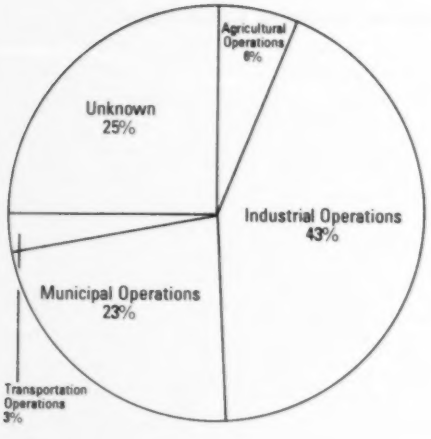

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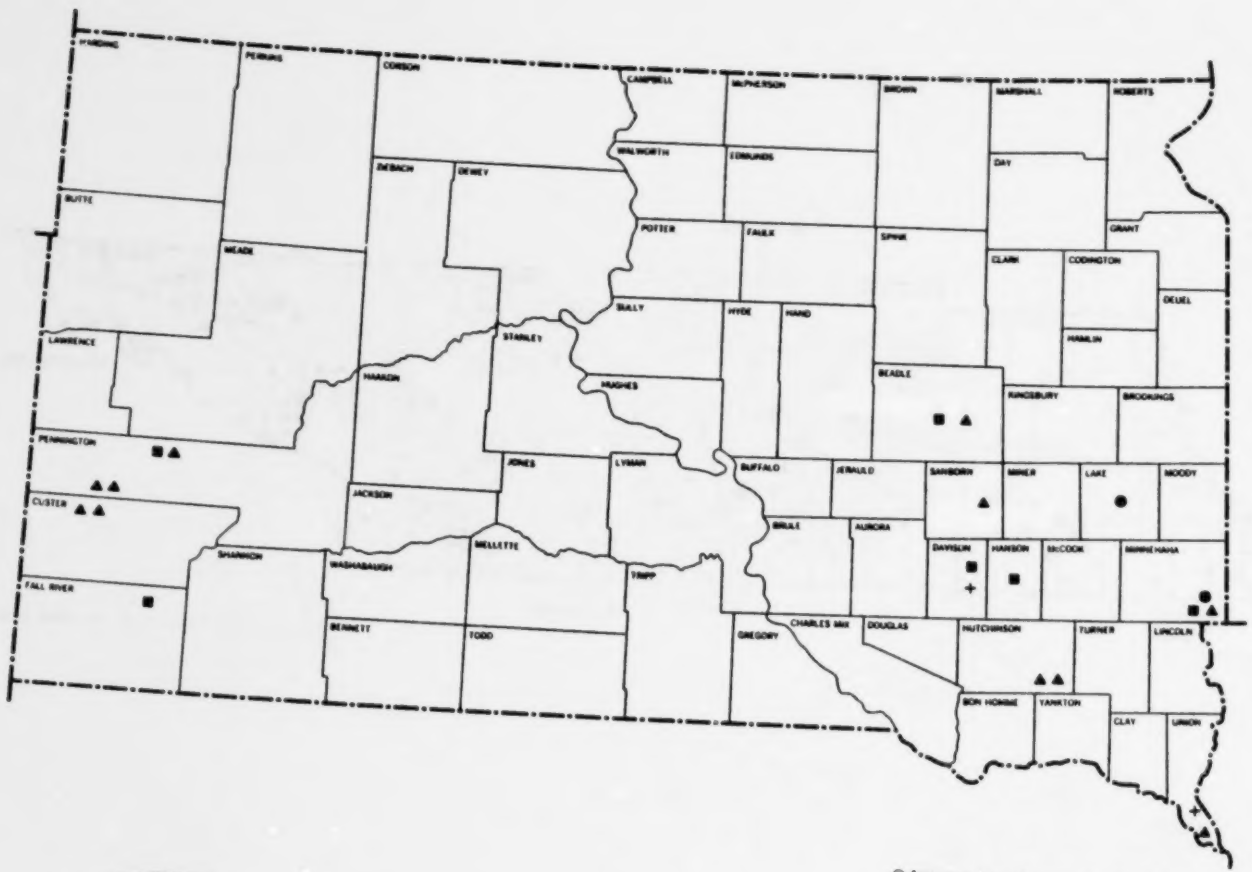
Figure 53
State of South Dakota—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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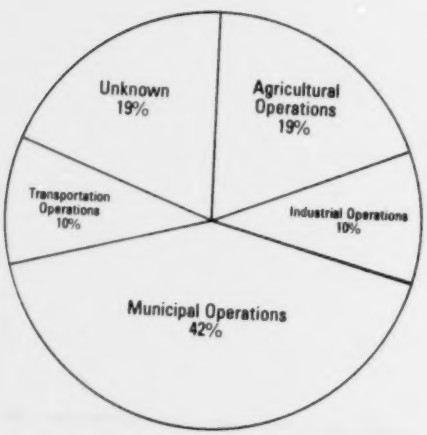
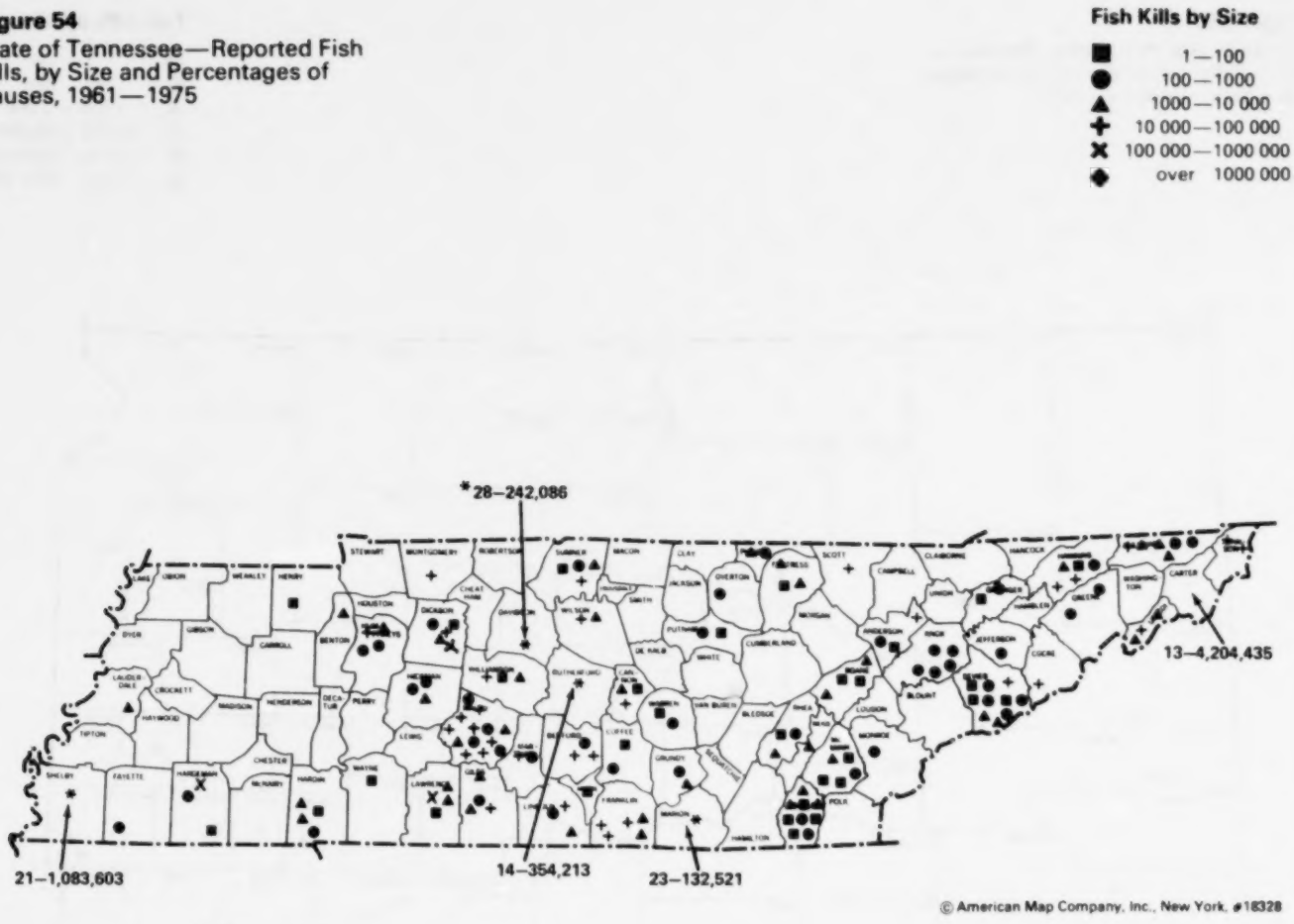


Figure 54
State of Tennessee—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



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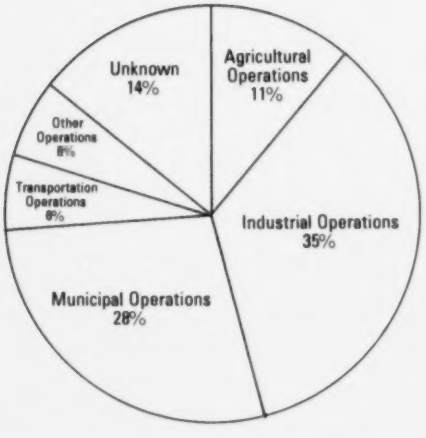
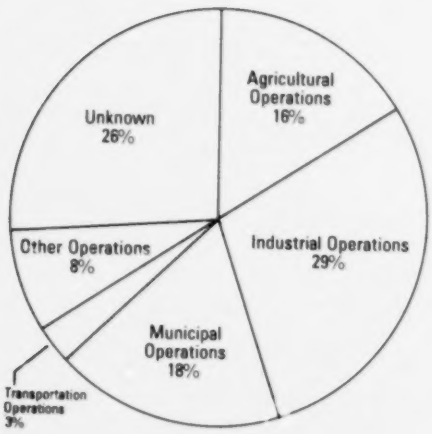


* Indicates the number of reports and the number of fish killed.

Figure 55
State of Texas—Reported Fish Kills, by Size and Percentages of Causes, 1961–1975



Note:
See list of fish kills, by reporting counties, which follows.

State of Texas—List of Fish Kills, by Reporting Counties

State code	County name	Number of reports	Number of fish killed
001	Anderson	6	3,100
005	Angelina	6	10,450
007	Aransaw	2	1,000
009	Archar	2	0
013	Atascosa	1	1,000
025	Bee	5	2,506
027	Bell	9	9,100
029	Bexar	38	342,450
035	Bosque	3	4,250
039	Brazoria	45	2,395,970
041	Brazos	2	600
057	Calhoun	10	2,121
061	Cameron	6	5,015,000
067	Cass	2	1,505
071	Chambers	19	15,687,400
073	Cherokee	3	16,000
075	Childress	2	0
077	Clay	3	1,000
081	Coke	5	47,000
083	Coleman	1	0
085	Collin	4	5,000
089	Colorado	4	600
093	Comanche	2	1,000
101	Cottle	1	0
105	Crockett	1	0
107	Crosby	1	5,000
111	Dallam	3	9,000
113	Dallas	13	164,516
117	Deaf Smith	5	1,000
121	Denton	6	2,450
123	Dewitt	1	2,000
127	Dimmit	1	0
129	Donley	1	0
133	Eastland	4	500
139	Ellis	4	0
141	El Paso	2	3,000
143	Erath	2	350
149	Fayette	2	200
157	Fort Bend	10	35,813
161	Freestone	3	5,500
167	Galveston	61	18,546,526
171	Gillespie	2	2,000
181	Grayson	1	0
183	Gregg	7	54,850
187	Guadalupe	2	1,000
193	Hamilton	2	1,000
199	Hardin	4	100
201	Harris	78	22,746,284
203	Harrison	6	2,500
209	Hays	2	1,500
211	Hemphill	1	0
217	Hill	2	0
221	Hood	2	1,500
225	Houston	2	5,100
227	Howard	1	500
231	Hunt	2	0
233	Hutchinson	5	8,000
235	Irion	2	0
237	Jack	2	1,000
239	Jackson	1	200
245	Jefferson	16	136,250
251	Johnson	4	1,157
253	Jones	5	350
257	Kaufman	4	100
265	Kerr	1	300
277	Lamar	2	0
281	Lampassa	7	1,075
285	Lavaca	10	24,400
287	Lee	1	5,000
289	Leon	2	300
291	Liberty	4	1,250
293	Limestone	5	750
295	Lipscomb	1	0
299	Llano	3	750
303	Lubbock	5	1,240
307	McCulloch	5	100
309	McLennan	7	8,994
313	Madison	2	2,000
315	Marion	7	1,764
321	Matagorda	13	105,731
323	Maverick	1	1,000
325	Medina	4	3,900
327	Menard	2	1,300
333	Mills	2	1,000
335	Mitchell	7	6,600
339	Montgomery	10	33,810
341	Moore	1	1,000
343	Morris	11	900
347	Nacogdoches	9	32,200
349	Navarro	3	500
351	Newton	1	1,737
353	Nolan	5	2,100
355	Nueces	13	106,978
361	Orange	2	550
363	Palo Pinto	1	500
365	Panola	2	10,000
369	Parmer	2	3,000
371	Pecos	3	1,500
373	Polk	3	600
381	Randall	10	292,000
389	Reeves	3	1,685
391	Refugio	1	2,500
395	Robertson	5	12,250
399	Runnels	3	0
401	Rusk	6	1,350
407	San Jacinto	3	0
417	Shackelford	1	0
419	Shelby	1	0
423	Smith	2	0
425	Somervell	2	1,200
429	Stephens	1	0
439	Tarrant	13	47,200
441	Taylor	2	10,000
449	Titus	6	1,400
451	Tom Green	11	15,300
453	Travis	13	119,700
455	Trinity	3	3,000
459	Upshur	1	0
463	Uvalde	1	500,000
465	Val Verde	2	2,200
467	Van Zandt	3	50
469	Victoria	4	550
471	Walker	2	2,250
473	Waller	1	0
475	Ward	2	0
481	Wharton	6	3,000
485	Witchita	5	1,050
487	Wilbarger	1	750
489	Willacy	1	1,000
491	Williamson	1	1,000
497	Wise	3	1,700
499	Wood	2	900
503	Young	5	11,006
507	Zavala	3	2,000

Figure 56
State of Utah—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

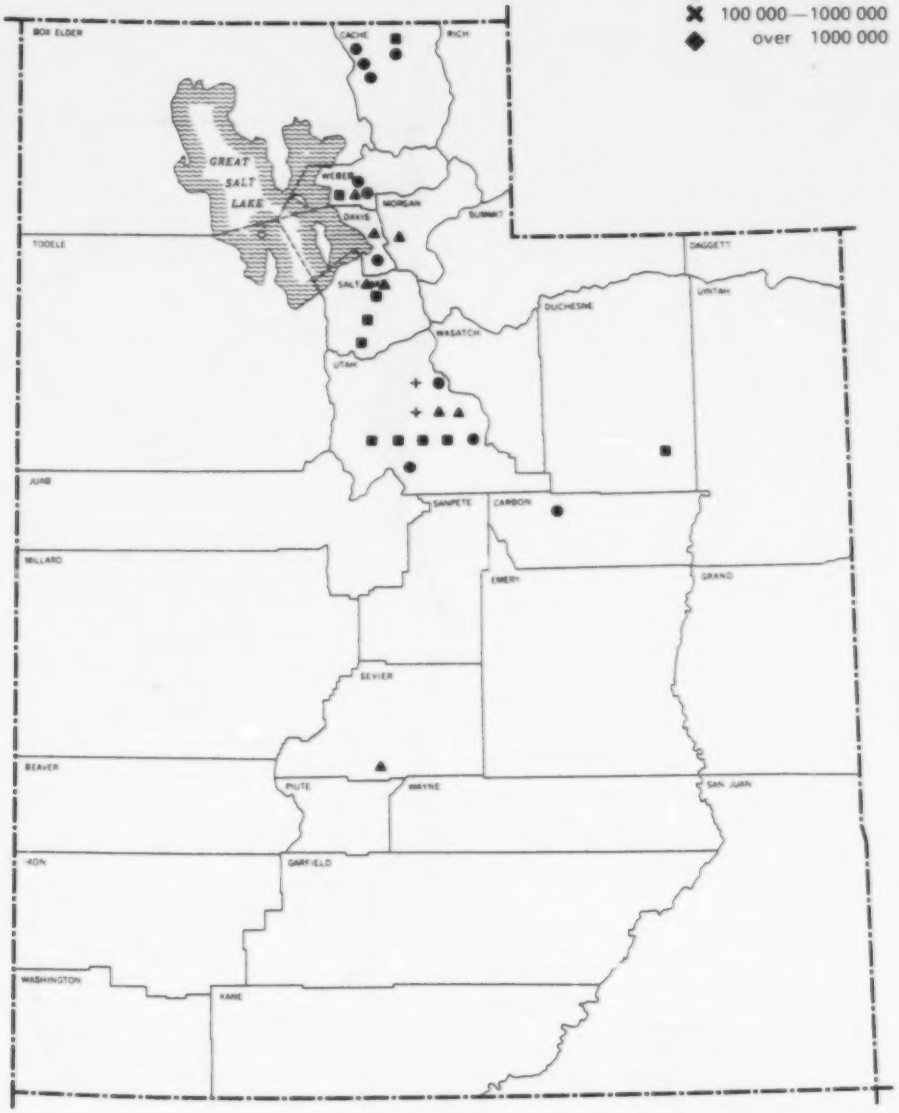


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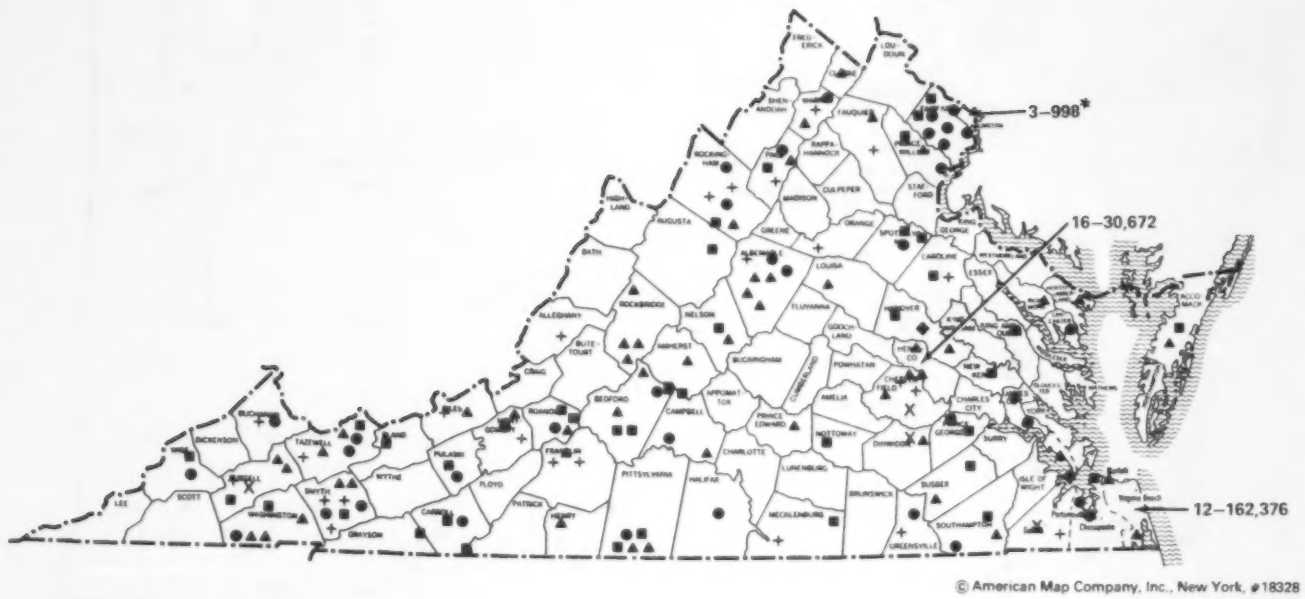
Figure 57
State of Vermont—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Figure 58
State of Virginia—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

Fish Kills by Size

- ■ 1—100
- ● 100—1000
- ▲ 1000—10 000
- ✚ 10 000—100 000
- ✖ 100 000—1000 000
- ◆ over 1000 000



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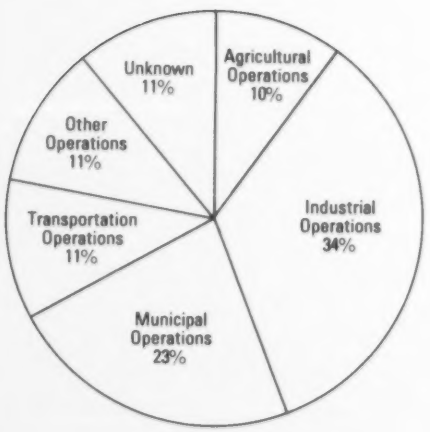


* Indicates the number of reports and the number of fish killed.

Figure 59
State of Washington—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975

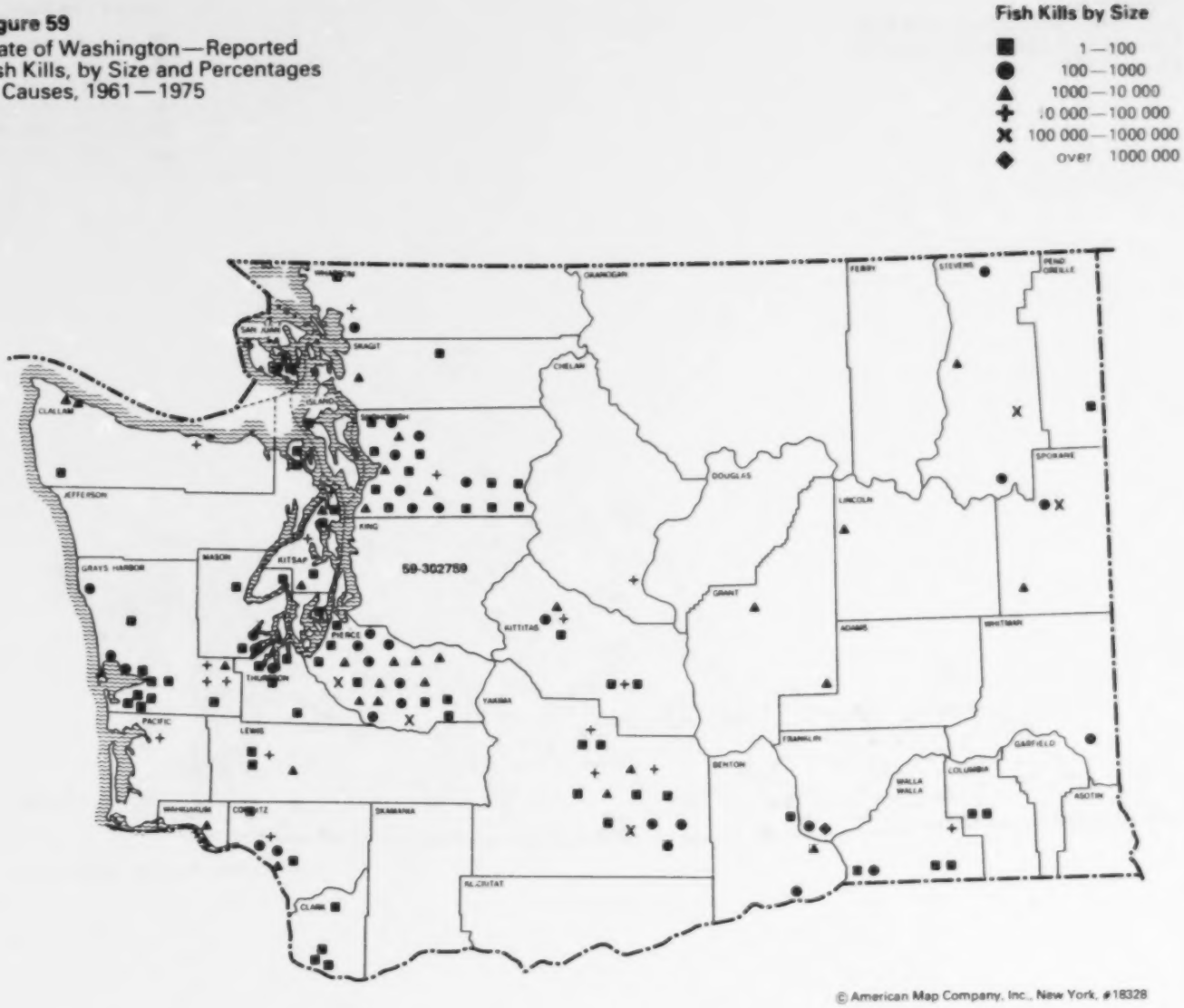
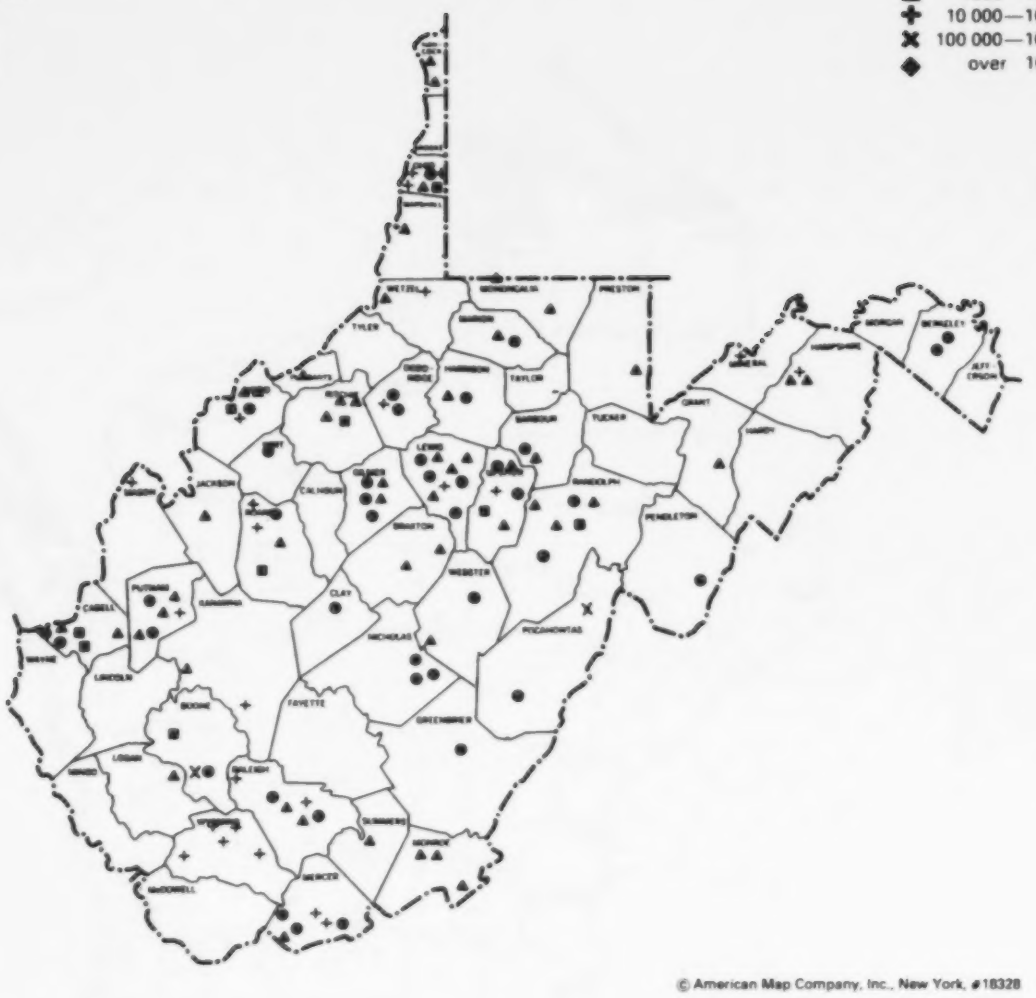


Figure 60
State of West Virginia—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



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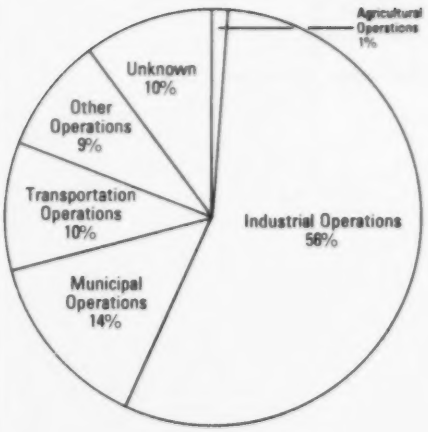
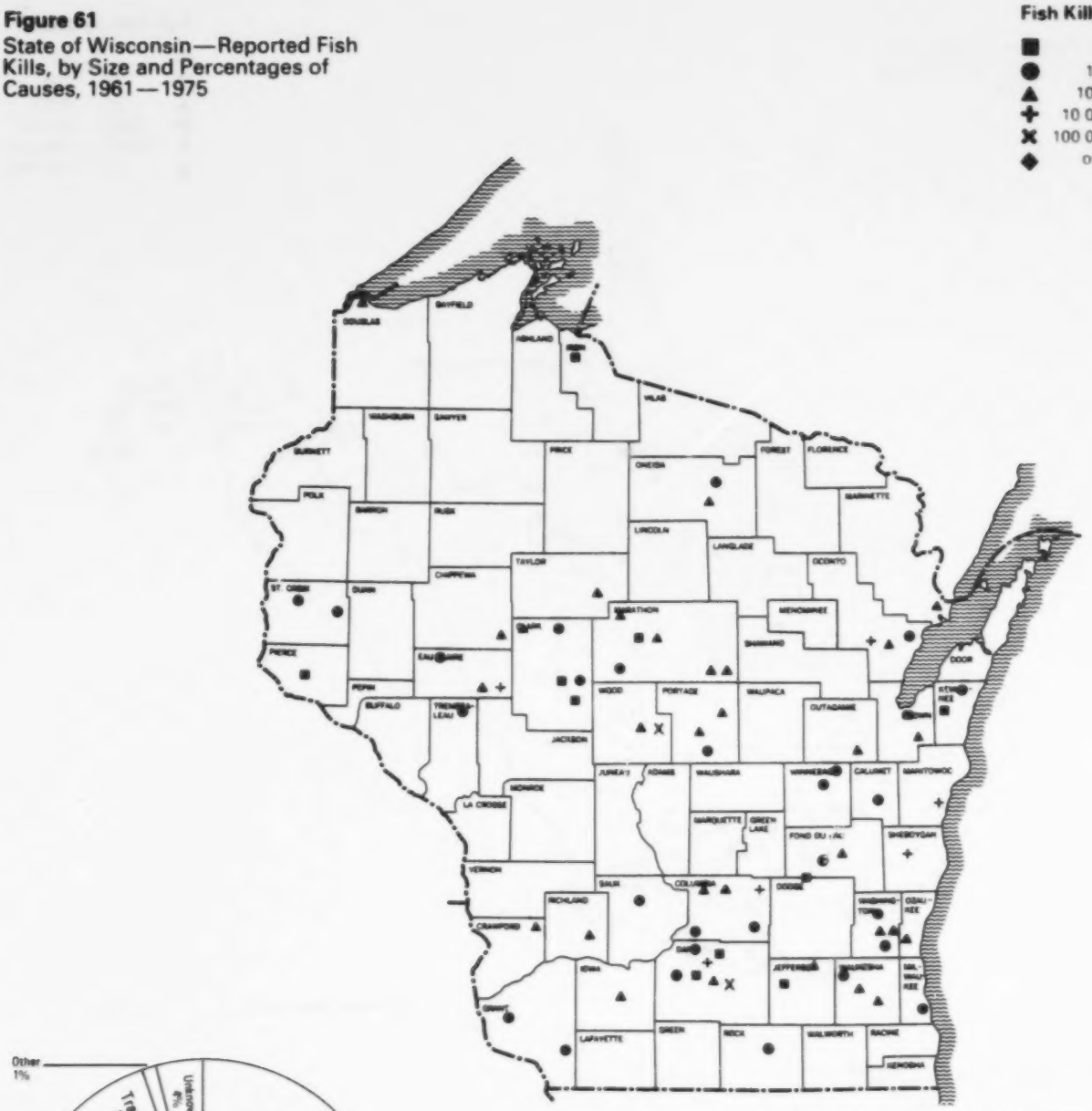


Figure 61
State of Wisconsin—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



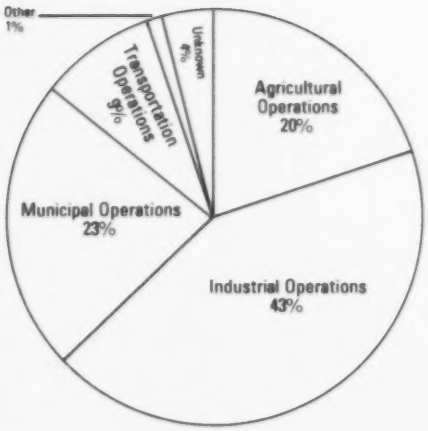
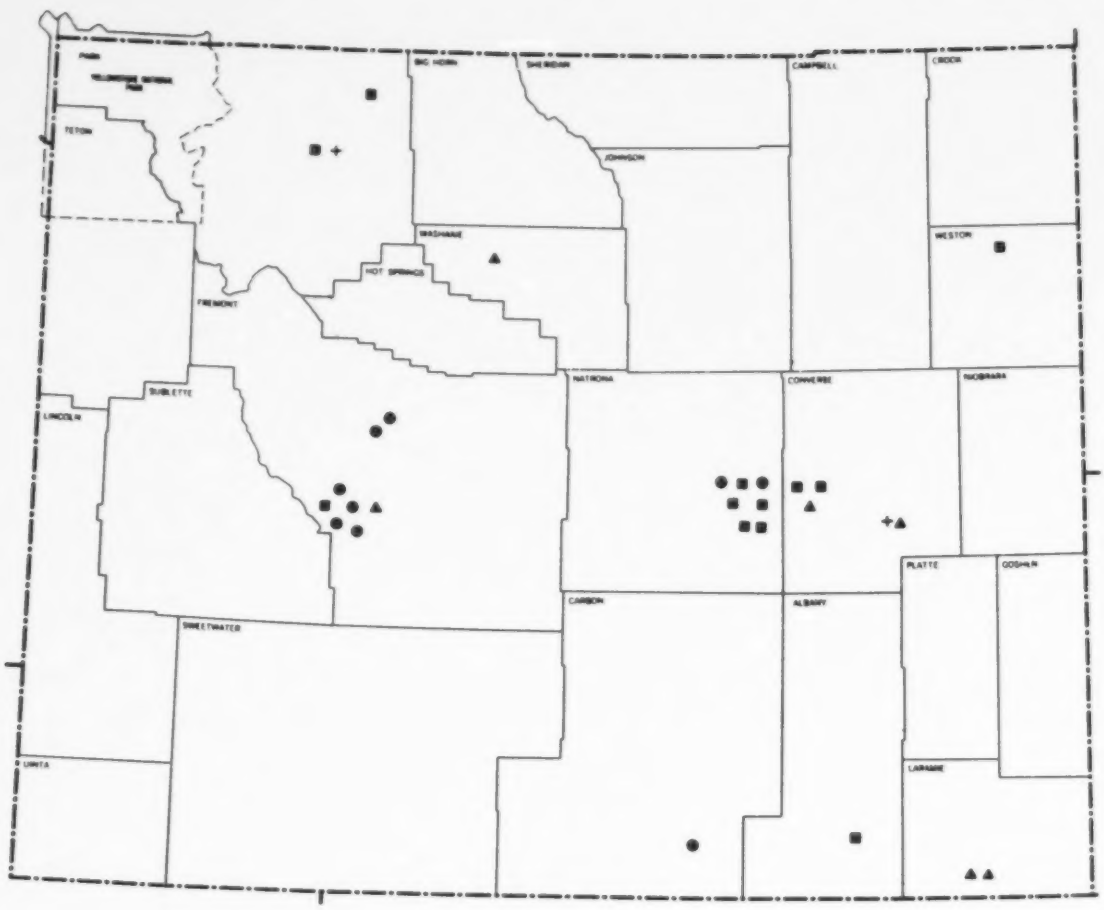


Figure 62
State of Wyoming—Reported Fish Kills, by Size and Percentages of Causes, 1961—1975



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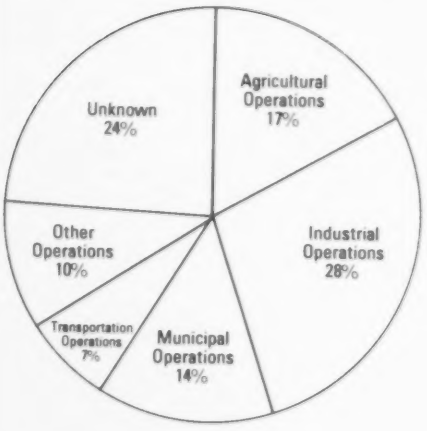

Appendices

Introduction

Appendix A lists the State agencies actively participating in the fish kill reporting program. Observers are encouraged to report any sightings of dead fish to their appropriate State agency. Since, if the cause is not readily apparent, time is important to an investigation, reports should be submitted as soon as possible, preferably by telephone to the local offices of the agency (game wardens, for example). If no local office is present, reports can be mailed to the agency at the addresses shown.

Appendix B is a reproduction of the report form showing information desired. It is recognized that the casual observer cannot normally provide much of the information; however, location, estimates of the number of dead fish and tissue and date of the observation are extremely important. Also important is the probable source of pollution where it can be identified.

Appendix C defines pollution sources in terms of the type of operation involved. Since the number of dead fish may not be indicative of the severity of the pollution, proper State officials should be notified even when only a small number of dead fish are seen floating on a water body. In cases where the fish kill was due to causes other than man-created pollution, State officials are still interested in determining the cause, and should be nofified.

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Appendix A

State Agencies

Alabama Department of Conservation
Game and Fish Division
Fisheries Section
64 North Union Street
Montgomery, Alabama 36104

Water Improvement Commission
Surveillance and Monitoring Section
749 State Office Building
Montgomery, Alabama 36104

Department of Fish and Game
Habitat Protection Section
Subport Building
Juneau, Alaska 99801

Arizona Game and Fish Department
2222 West Greenway Road
Phoenix, Arizona 85023

Arkansas Game and Fish Commission
Fisheries Division
Little Rock, Arkansas 72201

California Department of Fish and Game
Environmental Services Branch
1416 Ninth Street
Sacramento, California 94814

Department of Natural Resources
Division of Wildlife
6060 Broadway
Denver, Colorado 80216

Connecticut Board of Fisheries and Game
Fish and Water Life Unit
Department of Environmental Protection
State Office Building
Hartford, Connecticut 06115

Department of Natural Resources and Environmental Control
Division of Fish and Wildlife
Fisheries Section
Dover, Delaware 19901

Florida Department of Environmental Regulation
2562 Executive Center Circle, East
Montgomery Building
Tallahassee, Florida 32301

Georgia Game and Fish Commission
Trinity-Washington Street Building
270 Washington Street, S.W.
Atlanta, Georgia 30334

Division of Fish and Game
1179 Punchbowl Street
Honolulu, Hawaii 96813

Idaho Fish and Game Department
Bureau of Fisheries
P.O. Box 25
Boise, Idaho 83707

Illinois Department of Conservation
Division of Fisheries
605 State Office Building
400 South Spring Street
Springfield, Illinois 62706

Indiana State Board of Health
Division of Water Pollution Control
Water Quality and Standards Branch
1330 West Michigan Street
Indianapolis, Indiana 46206

Iowa State Conservation Commission
300 4th Street
Des Moines, Iowa 50319

Kansas Forestry, Fish and Game Commission
P.O. Box 1028
Pratt, Kansas 67124

Department of Fish and Wildlife Resources
Capital Plaza Tower
Frankfort, Kentucky 40601

Louisiana Stream Control Commission
Drawer F.C., University Station
Baton Rouge, Louisiana 70803

Fish and Game Department
State Office Building
Augusta, Maine 04330

Maryland Department of Water Resources
State Office Building
Annapolis, Maryland 21401

Massachusetts Department of Natural Resources
Division of Marine Fisheries
State Office Building
Government Center
100 Cambridge Street
Boston, Massachusetts 02202

Massachusetts Division of Fisheries and Game
Field Headquarters
Westboro, Massachusetts 01581

Water Resources Commission
Department of Natural Resources
Stevens T. Mason Building
Lansing, Michigan 48926

Minnesota Department of Natural Resources
Division of Fish and Wildlife
390 Centennial Building
St. Paul, Minnesota 55155

Mississippi Air and Water Pollution Control Commission
P.O. Box 827
Jackson, Mississippi 39205

Missouri Department of Conservation
1110 College Avenue
Columbia, Missouri 65201

Missouri Department of Conservation
Division of Fisheries
P.O. Box 180
Jefferson City, Missouri 65101

Department of Fish and Game
Room 134, Cogswell Building
Helena, Montana 59601

Nebraska Game and Parks Commission
2200 North 33rd Street
Lincoln, Nebraska 68503

Nevada Department of Fish and Game
P.O. Box 10678
Reno, Nevada 89510

New Hampshire Water Supply and Pollution Control Commission
P.O. Box 95
Concord, New Hampshire 03301

Division of Fish, Game and Shellfisheries
Bureau of Fisheries Laboratory
Lebanon, New Jersey 08833

New Mexico Department of Game and Fish
State Capitol
Santa Fe, New Mexico 87501

Department of Environmental Conservation
Albany, New York 12201

North Carolina Department of Water and Air Resources
Box 27048
Raleigh, North Carolina 27611

North Dakota Game and Fish Department
Fisheries Division
103½ South Third Street
Bismarck, North Dakota 58501

Ohio Department of Natural Resources
Division of Wildlife
Fountain Square
Columbus, Ohio 43224

Oklahoma Department of Wildlife Conservation
Fisheries Division
1801 North Lincoln Bouelvard
Oklahoma City, Oklahoma 73105

Fish and Wildlife Commission
307 State Office Building
Portland, Oregon 97201

Pennsylvania Fish Commission
P.O. Box 1673
Harrisburg, Pennsylvania 17120

Rhode Island Department of Natural Resources
Division of Fish and Wildlife
83 Park Street
Providence, Rhode Island 02903

South Carolina Wildlife and Marine Resources Department
Division of Game
P.O. Box 167
Columbia, South Carolina 29202

South Dakota Department of Game, Fish and Parks
Division of Game and Fish
State Office Building # 1
Pierre, South Dakota 57501

Tennessee Game and Fish Commission
Doctors Building, Room 600
Nashville, Tennessee 37203

Texas Parks and Wildlife Department
Fish and Wildlife Division
John H. Reagan Building
Austin, Texas 78701

Utah Department of Natural Resources
Division of Fish and Game
1596 West North Temple
Salt Lake City, Utah 84116

Vermont Fish and Game Department
Research and Management Center
Roxbury, Vermont 05659

Virginia State Water Control Board
Bureau of Enforcement
P.O. Box 11143
Richmond, Virginia 23230

Washington State Department of Ecology
P.O. Box 829
Olympia, Washington 98501

West Virginia Department of Natural Resources
Division of Wildlife Resources
Charleston, West Virginia 25305

Wisconsin Department of Natural Resources
Bureau of Standards and Surveys
Box 450
Madison, Wisconsin 53701

Department of Natural Resources
Bureau of Water Quality
Box 450
Madison, Wisconsin 53701

Wyoming Game and Fish Department
Box 712
Lander, Wyoming 82520

Appendix B

Report of Pollution Caused Fish Kill Sample Form

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER PLANNING AND STANDARDS
WASHINGTON, D.C. 20460

REPORT OF POLLUTION-CAUSED FISH KILL

Form Approved OMB No. 158-R0036

FOR OWP USE ONLY

1A. LOCATION *(Name of Body of Water, Latitude-Longitude)*

2. DATE OF KILL

B. NEAREST TOWN AND COUNTY

C. STATE

3. TYPE OF WATER
☐ FRESH ☐ SALT ☐ ESTUARY

4. POLLUTION SOURCE - TYPE OF OPERATION

A. AGRICULTURAL OPERATIONS
- ☐ POISONS *(Pesticides, etc)*
- ☐ FERTILIZERS
- ☐ MANURE DRAINAGE, ENSILAGE LIQUORS, OR FEED LOT OPERATIONS
- ☐ HANDLING OF EQUIPMENT AND CONTAINERS

B. INDUSTRIAL OPERATIONS
- ☐ MINING
- ☐ METALS
- ☐ CHEMICALS
- ☐ PETROLEUM
- ☐ FOOD AND KINDRED PRODUCTS
- ☐ PAPER AND ALLIED PRODUCTS
- ☐ TEXTILES
- ☐ RUBBER AND PLASTICS
- ☐ OTHER:

C. MUNICIPAL OPERATIONS
- ☐ SEWERAGE SYSTEM
- ☐ REFUSE DISPOSAL
- ☐ WATER SYSTEM
- ☐ SWIMMING POOL
- ☐ POWER *(Public Service)*
- ☐ PEST CONTROL

D. TRANSPORTATION OPERATIONS
- ☐ RAIL ☐ TRUCK ☐ BARGE OR BOAT
- ☐ PIPELINE ☐ AIR

E. CONSTRUCTION OR OTHER
- ☐ CONSTRUCTION
- ☐ OTHER:

F.
- ☐ UNKNOWN

G. SPECIFIC POLLUTANT OR FACTOR CHANGING WATER CHARACTERISTICS
(Name of chemical, thermal discharge, etc.)

5. TYPE OF FISH KILL

GAME	%
NON-GAME	%
TOTAL	100 %
COMMERCIAL	%

6. EST. NO. KILLED

7. SEVERITY
☐ TOTAL ☐ HEAVY ☐ MOD. ☐ LIGHT

8. EXTENT OF AREA AFFECTED

A. MILES OF STREAM	B. ACRES OF LAKE

9. DURATION OF CRITICAL EFFECT

A. DAYS	B. HOURS

10A. SPECIES OF FISH KILLED *(If known)*

B. ADDITIONAL REMARKS *(Include effects on other than marine life, e.g., shellfish, waterfowl, etc.)*

11. REPORTING OFFICIAL

12. AGENCY MAILING ADDRESS

13. DATE OF REPORT

EPA Form 7500-8 (Rev. 9-78) PREVIOUS EDITION MAY BE USED UNTIL SUPPLY IS EXHAUSTED.

INSTRUCTIONS: Upon completion fold card to show proper address and staple or tape long edge together.

Appendix C

Glossary

Sources of Pollution by Type of Operation

Fish kills may be caused by pollution from a large number and variety of sources. To facilitate reporting of kills, these pollution sources have been categorized according to the types of operations (municipal, industrial, etc.) producing the pollution. Following are definitions of each operation to include breakdowns into subcategories.

Agricultural Operations

Pollution from agricultural operations results primarily from wastewater runoff from fields where various chemical compounds are used for pest control and fertilizers. Runoff from feedlot operations are also included under this category. In addition, a probable cause of pollution lies in the handling of various pesticides or fertilizers, the cleaning of equipment used to disperse these chemicals, and the handling and disposal of the containers.

- Poisons (Pesticides, Etc.)
Poisons include any of the "cides" used at the site of agricultural operations, which may be introduced into a water body through a runoff after a rain or through settling from the air.

- Fertilizers
This subcategory applies to commercial fertilizers after they have been delivered for use.

- Manure Drainage, Ensilage Liquors, or Feed Lot Operations
In addition to the operations named in this heading, this subcategory includes other agricultural operations which may be a source of pollution through poor housekeeping practices.

- Handling of Equipment and Containers
This subcategory includes washing of equipment, handling and storage of pesticide or fertilizer compounds before use, and container disposal.

Construction, or Other

- Construction operations such as the building of highways, dams, industrial complexes and other structures in or near waterways, are a frequent source of pollution.

The following are examples of the "other" category.

- Large residential or custodial facilities not connected to municipal sewers but having their own system, for example, Federal, State, and church institutions, custodial institutions such as old folks homes, universities, etc.

- Domestic service operations in suburban or rural areas resulting in direct discharges such as spent drycleaning solutions and wash and rinse water from coin laundries and dry cleaners, and spent floor and paint cleaners.

- Highway restaurants, motels, resort areas, and auto service areas which may or may not have their own treatment plant.

Industrial Operations

Industrial operations involve manufacturing or processing industrial and commercial products.

- Mining
Pollution from mining operations is most often caused by acid mine drainage from coal mines. In addition, coal washings and taconite tailing disposal are included here as well as side products from all other mining operations, including mining for ore, limestone, phosphate, etc.

- Chemicals
This subcategory includes manufacture of the following:
Basic chemicals such as acids, alkalies, salts, and organic chemicals;
Chemical products to be used in further manufacture such as synthetic fibers, plastic materials, dry colors, and pigments; and,
Finished chemical products for ultimate consumption (cosmetics, drugs and soaps); or to be used as materials or supplies in other industries (paints, fertilizers, and explosives).

- Food and Kindred Products
These operations include those involved in preparing and processing fresh and raw food items and other related products for the market. Examples include:
Sugar refining;
Canning, dehydrating, freezing, or curing of fruits, vegetables, or fish and other seafood;
Grain processing into flour, cereal products, etc.;
Slaughtering or meat packing;
Dressing poultry;
Any milk-handling operation including dairy farm, cheese factory, condensery, creamery, or ice cream plant;
Breweries, wineries, or distilleries operations;
Rendering plants or vegetable oil manufacture; and,
Animal feed manufacture.

- Textiles
Textile production covers all milltype operations, including bleaching and dyeing processes.

- Metals

This subcategory includes all operations involving metals and plating (except mining), such as blast furnaces, smelting, rolling mills, pickling, heat treatment, etc. Common sources of wastes are metal cleaning solutions and plating vats which contain large amounts of acid, cyanide, copper, iron, chrome, and arsenic, all of which are specific causes of fish kills.

In addition, coke ovens and inefficient clarifier tanks in steel mills add toxic chemicals and turbidity to waste water.

- Petroleum

Petroleum covers oil or gas well drilling, oil refining, and the manufacture of any petroleum products.

- Paper and Allied Products

Paper and allied products covers paper-making in any of its stages, including resultant sludge deposits in streams or lakes.

- Rubber and Plastics

This subcategory includes manufacture from natural, synthetic, or reclaimed rubber. It also includes manufacturing involved in molding primary plastics for trade, and miscellaneous finished plastic products.

- Other Industrial

"Other" applies to those industries not specifically designated. The following are examples of potential entries under this item.

Lumber and wood products production including logging, chemical treatment, and sawmill operations through the finished product;

Leather and leather products processing and production;

Sand and gravel washing; and,

Automobile manufacturing.

Municipal Operations

Municipal operations are those activities that are the responsibility of the municipality in providing public utilities and other services.

- Sewerage System

Includes municipal sanitary and storm sewers and combined sewers. The wastes may be treated or untreated before they enter or leave the municipal system.

- Refuse Disposal

Refuse disposal concerns dumps, land fill projects, etc., used for disposal of solid wastes. The prime cause of fish kills from these sources is drainage from these areas, and deposits of ash from incinerators into surface water bodies.

- Water System

Fish kills charged to water system include kills caused by excessive use of chemicals for pipe cleaning and for algae, weed, and insect control in reservoirs. A common source of kills from this source is high chlorine solutions drained from new pipe lines, storage tanks, reservoirs, and pump stations, which are used to sterilize new water supply facilities.

- Swimming Pools

Fish kills charged to swimming pool operations generally result from cleaning operations or use of excessive chlorine. This subcategory applies if pool drainage is not connected to the city sewer system, regardless of who owns or operates the pool.

- Power (Public Service)

Power generation considered here is the production of power intended for consumption by the general public, versus power generation necessary to operate a manufacturing plant. Thermal pollution is of prime concern, although wastewaters such as that from boiler blowdown sometimes cause fish kills, most often during low flows.

- Pest Control

This subcategory of operations includes spraying of ponds, creeks, marshes, or use of other various methods of insect control when the poisons used are deposited directly into a waterway, as opposed to being conveyed to the waterway via a municipal sewer system.

Transportation Operations

The major source of pollution from these operations is accidental spillage into waterways of products in transit regardless of source, destination, or ultimate use.

- Rail

Fish kills charged to this subcategory are caused by accidental product spills, whether due to a wreck or by handling in yards. Waste discharge from railyard operations also applies here.

- Pipeline

Pipeline means those lines used to transport liquids or gases for long distances.

- Truck

A fish kill charged to this subcategory most often results from a wreck, leakage, or careless handling in transit and at terminals.

- Air

This subcategory includes operation of airports, which are frequent producers of oily wastes and highly alkaline aircraft washrack drainage, as well as aircraft operations. It also includes aircraft crashes which should be considered in the same light as accidents involving trains, trucks, boats, etc.

- Barge or Boat

Barge or boat operations may result in pollution through spillage of products resulting from bilge discharges, fire, collision, sinking, or mishandling the products while in transit. Transit, in this case, includes transfer to or from the vessel while docked.

Unknown

The unknown category is applied to a fish kill when the pollution source operation cannot be determined or surmised, and the investigator is reasonably sure that the kill was due to pollution.

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